The State of Britain's Mammals 2006

Written by David Macdonald
and Sandra Baker

Summary




1. Twelve years after publication, the UK Biodiversity Action Plan has been undergoing its first full review.

- The 2005 reporting round indicated increasing trends for otters, greater and lesser horseshoe bats, and probably common pipistrelles, with decreasing trends for dormice, water voles and red squirrels.
- The Species and Habitats Review should be complete by November 2006. The best available data are being used to produce a new draft UK BAP List of Species and Habitats. A suite of implementation mechanisms will be developed to conserve the approved list.

2. The Animal Welfare Bill introduces new protection not only for domesticated animals, but also for wild animals, where they have come under the control of man. The Bill also includes new legislation relating to the use of animals for fighting, such as badger baiting.

3. Clarification is required regarding existing legislation on trapping polecats, and action is needed to encourage trappers to release polecats caught accidentally.

4. We focus on three groups of mammals not covered by the BAP:

- *Marine mammals*. UK harbour seal populations were devastated by phocine distemper outbreaks in 1988 and 2002. The disease may have been transmitted from Arctic seals by resistant grey seals. Better information is required on seal movements to assist in the management of future outbreaks.
- *Riparian mustelids*. New research suggests that otters returning to the UK may be having a negative impact on mink through intra-guild competition.
- *Extinct species under consideration for reintroduction*. We examine the possibilities of reintroducing formerly native wild boar, Eurasian beavers and Eurasian lynx to Britain.

5. The link between military sonar and beaked whale beachings is universally accepted, but the mechanism remains unknown. A current front-runner, the 'bubble hypothesis', suggests that directly or indirectly the intense sound gives whales 'the bends'; this has new and unexpected implications for the animal's biology.

6. Over the last five years, summer sea surface temperatures have increased in UK waters, partly as a result of the North Atlantic Oscillation (NAO) being in a positive phase. Warm water dolphin species now occur regularly in the North Sea, and shifts in the ranges of predatory cetaceans may be a result of warmer waters affecting prey availability. It remains to be seen whether global climate change will delay the North Atlantic Oscillation (NAO) entering a negative stage, thereby exacerbating these effects.

7. The British Trust for Ornithology and the Mammal Society have published the results of their new *Winter Mammal Monitoring* pilot survey. They conclude that the system could be used to monitor gross trends in a number of species.

8. All six species of free-ranging deer in Britain have expanded their national ranges over the last 30 years. This pattern of spread is likely to continue for the foreseeable future, with roe deer predicted to have expanded to 79% of the country by 2012.

9. We describe two innovations in mammal monitoring:

- Waterford Institute of Technology has developed an effective pine marten hair tube for collecting DNA samples for use in population surveys.
- Researchers at Queen's University, Belfast, and the Central Science Laboratory are pioneering isotope analysis of mammalian tissues. So far they have used this technique to study resource partitioning among bats, exposure to environmental contaminants in foxes, and the efficacy of mink eradication.

10. We examine recent research aimed at managing human-mammal conflict:

- The University of Oxford has demonstrated that learned food aversions might potentially be used to control badger feeding damage.
- The University of Aberdeen is investigating whether radiation sources might be used to reduce bat-turbine collisions.
- Jochen Langbein is testing acoustic deer deterrents triggered by headlights or vehicle vibrations.
- The University of Bristol has demonstrated that hedgehogs allowed to build up fat reserves in captivity prior to release are better equipped for translocation.

11. In May 2005, MTUK sponsored a Think Tank on the links between infectious disease and mammalian conservation:

- Research by the University of Oxford and Central Science Laboratory has demonstrated that badger culls, aimed at controlling bovine tuberculosis among cattle, actually disturb the behaviour of surviving badgers in such a way that might exacerbate disease spread.
- Other issues examined include rabies in bats, the squirrel poxvirus, and health screening of water voles prior to release.

12. In the five years since its launch MTUK has granted more than £500,000 for work on British mammals.

Preface

SOMETHING ABOUT THE NUMBER of digits on the original mammalian limb makes a fifth anniversary seem especially portentous. Perhaps, therefore, in this Preface to the fifth annual update following the publication of *Britain's Mammals: The Challenge for Conservation* (2001), it is a moment to take stock. Skimming through that report (still available from MTUK), reveals that the first eighty pages are devoted to identifying the issues - the same general issues remain current today. Conflict with non-native species, including issues of competition, hybridisation and disease transmission, are ever higher on the agenda. Toxic influences on habitats remain a worry, although effective regulation is providing solutions. Climate change has rocketed up the agenda and is widely accepted as the greatest long-term symptom of environmental peril. However, the greatest ultimate driver of the extinction crisis and general environmental degradation remains human population growth and consumption, and hence habitat loss is as high on the list of issues as ever. In almost every case, knowledge uncovered in the last few years has nudged policy-makers towards new understandings based on firmer evidence.

This year sees two major opportunities for policy to build on this maturing understanding. First, government has the chance to demonstrate the primacy of evidence in its decision-making process. The blight of bovine tuberculosis in cattle is an appalling threat to dairy farmers, especially in southwest England. Much research has been devoted to testing the hypothesis that killing badgers significantly reduces the disease in cattle. Some commentators remark that the results are equivocal or insufficient to draw a conclusion. This is puzzling, because the results are actually now abundant, and relatively straightforward, and the hypothesis can be rejected – killing badgers at a scale and efficiency hitherto feasible in southwest England has not reduced significantly the incidence of bTB in cattle, and offers little realistic prospect of doing so (it may make things worse: see page 16). The evidence thus tells us what not to do, even if we do not yet know what to do. The balance of costs and benefits in this agonising dilemma therefore suggest that a new badger cull is not the solution, and it will be interesting to see whether government has the moral fortitude to act on the evidence.

The second new understanding with significant policy implications is that human well-being is an integral part of conservation. This is embodied in the Natural Environment and Rural Communities Act 2006, and the resulting creation of Natural England. Natural England, scheduled to be vested in October 2006, will seek to integrate care for 'people, places and nature'. Thus conservation depends on blending natural, economic and social sciences, to align the diverse and legitimate constituencies affecting the environment[1]. Accepting the need for nature generally to benefit people is not, of course, to say that nature should be sacrificed to short-term human expediency. On the contrary, as biodiversity's national advocate, the challenge for Natural England will be to ensure that society comes to value nature sufficiently to unite in its conservation.

David Macdonald & Sandra Baker


Terry Whittaker

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UK BAP update

THE CONVENTION ON BIOLOGICAL DIVERSITY was signed in Rio de Janeiro in 1992. As a result the UK Government made a commitment significantly to reduce biodiversity loss by 2010. The UK Biodiversity Action Plan (UK BAP) was published in 1994, currently covering 45 habitats and 475 species, including 31 mammals covered by 13 single species action plans and three grouped cetacean plans[2]. The status of these priority species and habitats are among the draft headline indicators for the 2010 target. Monitoring and reporting against UK BAP targets are essential for assessing progress towards the 2010 target, identifying emerging issues and re-setting priorities. Twelve years on, the first full review of the UK BAP is nearing completion. This involves: (1) a national reporting round (every three years); (2) a review of the UK priority species and habitats; (3) a review of the targets set for these. The species and habitats review (see box) and targets review are still in progress, but highlights of the 2005 reporting round were published in June 2006[3]. A full report will be available from the UK BAP website in due course[2].

The fundamental measure of progress is whether the status of priority species and habitats is improving. Increasing trends were reported for 42 species (11%) including otters, and greater and lesser horseshoe bats. Common pipistrelles were recorded as fluctuating, but probably increasing. Stable status was recorded for 134 species (36%), including soprano pipistrelles and brown hares. Declines were reported for 102 species (27%), including water voles, dormice (decline slowing for both) and red squirrels (decline continuing or accelerating). The UK trend was unknown for 47 species (13%) including harbour porpoises and barbastelle and Bechstein's bats. Trends reported in 2005 for all priority mammal species were the same as in 2002, except that pipistrelles were then reported as a single stable species (not having been recognised as two separate species until 1999). No new data have been available on the status or trends among species covered by the grouped cetacean plans since the 1994 SCANS (Small Cetaceans in the European Atlantic and North Sea) survey. The results of SCANS 2 will not be available until 2006 at the earliest. The remaining UK BAP species, the greater mouse-eared bat, was lost prior to publication of the BAP[3].

Declining species are reported to be at risk from a range of potential threats. In England, Scotland and Wales, water voles are threatened by habitat loss and degradation, arising through housing infrastructure development, and by predation by American mink (there are no water voles in Northern Ireland). In England and Wales dormice are threatened by climate change and by habitat loss and degradation arising through housing infrastructure development, loss of hedgerows, and a decline in traditional woodland management practices such as coppicing (there are no dormice in Scotland or Northern Ireland). In England, Scotland and Wales, red squirrels are threatened by disease, and throughout the UK they are at risk of competition from grey squirrels, and habitat loss and degradation through inappropriate timing of forestry rotation and replanting woodland with inappropriate species.

UK BAP species and habitat review

The UK BAP species and habitats are being reviewed to ensure that the UK BAP remains focussed on the correct priorities for action and that all specialists and interested parties have an opportunity to contribute. The Biodiversity Reporting and Information Group (BRIG) are conducting this work in association with the JNCC Species Status Assessment Project.

The first stage began in July 2004 and is almost complete. The best available data were used to assess each species and habitat against various scientific and practical criteria, and to produce a new draft UK BAP List of Species and Habitats. The marine species list is still in preparation, but the terrestrial/freshwater species list is nearly complete. Eight new terrestrial/freshwater mammals are proposed for addition to the UK BAP and two species are nominated for removal; these will be revealed when the review has been approved and signed off. If all of the proposed additions and removals are approved, the number of terrestrial/freshwater mammals listed on the UK BAP will increase from 12 (see Table, less the harbour porpoise) to 18.

Finally a suite of implementation mechanisms will be developed to conserve the UK BAP List of Species and Habitats collectively. These are likely to be target-driven and the implementation process will probably be streamlined by integrating UK BAP work into existing delivery mechanisms, such as agri-environment schemes or policy based work, as well as some single and grouped plans. The priority lists and delivery mechanisms should be published in November 2006.

The UK BAP review & reporting

Species	Biological trend	Trend assessed on adequate data?	UK Status		Status assessed adequate data?
Otter	Increasing	Yes	2,219	occupied 10km squares	Yes
Greater horseshoe bat	Increasing	Yes	4,920	individuals	Yes
Lesser horseshoe bat	Increasing	Yes	18,000	individuals	No*
Common pipistrelle bat	Fluctuating	Yes	2,430,000	individuals	No*
Soprano pipistrelle bat	Stable	Yes	1,300,000	individuals	No*
Brown hare	Stable	Yes	817,500	individuals	Yes
Water vole	Declining slowly	Yes	730	occupied 10km squares	Yes
Dormouse	Declining slowly	Yes	376	occupied 10km squares	Yes
Red squirrel	Declining	No**	603	occupied 10km squares	No*
Barbastelle bat	Unknown	No*	5,000	individuals	No*
Bechstein's bat	Unknown	No*	1,500	individuals	No*
Harbour porpoise***	Unknown	No**	215	individuals	No*
Greater mouse-eared bat	Lost (pre-BAP publication)	Yes	1	individual	Yes

* Not likely by 2008

** Likely by 2008

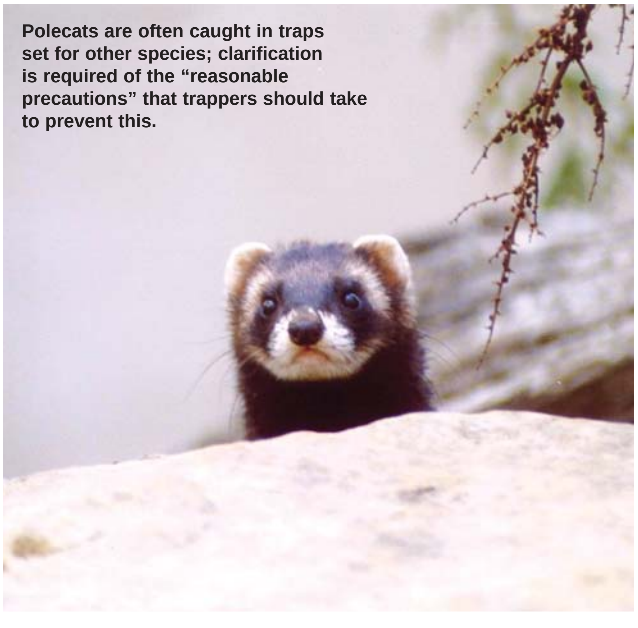
*** Based on data from Wales only

Legal issues surrounding polecat trapping

Polecats were trapped to extinction in lowland Britain at the end of the 19th century. Now polecats are recovering, but they are often caught in traps set for other species. Polecats caught in regularly checked cage traps may be released unharmed, however they are sometimes killed instead. Polecats are also injured or killed in spring traps (tunnel traps) designed (legally) to kill unprotected species such as stoats and weasels. Intentional trapping of polecats requires a licence, but apparently it is not illegal to retain in captivity, or shoot, a polecat caught accidentally. The Wildlife & Countryside Act (WCA) 1981 (as amended) requires trappers to take "reasonable precautions" to prevent injury to animals on Schedule 6, e.g. polecats. The Conservation (Natural Habitats &c.) Regulations 1994 prohibit the use of "non-selective" traps for taking or killing protected mammals such as polecats. The Spring Traps (Approval) Order 1995 specifically excludes their use for capturing species listed on Schedules 5 and 6 of the WCA 1981. None of this legislation has been tested in court with respect to polecats, and there is no interpretation of what "reasonable precautions" trappers should take, or whether accidental captures in tunnel traps are legally defensible.

In 2001, the Game Conservancy Trust (GCT) developed a device for excluding polecats from tunnel traps[4]. However while this allowed the passage of some target species, it excluded rats, squirrels, and potentially mink, and the GCT advocated discretionary use only. Anecdotal reports confirm that polecats continue to be killed or injured in tunnel traps; this is likely to increase as polecats spread further east into areas where game shooting and tunnel trapping are more prevalent.

Clarification is required of what "reasonable precautions" entail. Furthermore, action is needed, in partnership with game-keeping organisations, to encourage trappers to release polecats caught accidentally. These issues are particularly pressing given the poor status of polecats in the rest of Europe.



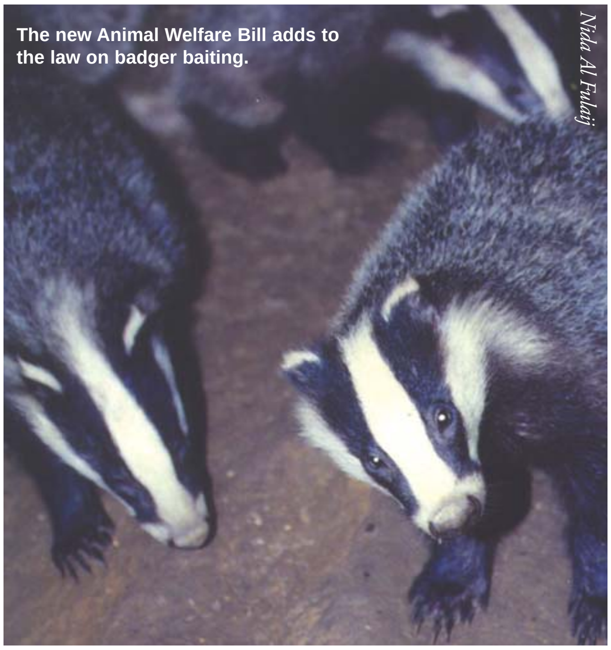
Polecats are often caught in traps set for other species; clarification is required of the "reasonable precautions" that trappers should take to prevent this.

Susan Sharafi

The Animal Welfare Bill

The Animal Welfare Bill marks a milestone in animal welfare legislation, by consolidating and modernising welfare legislation relating to farmed and non-farmed animals[5]. Importantly, the Bill introduces a new duty to care for animals - obliging those responsible for animals to take reasonable steps to meet their welfare needs, to the extent required by 'good practice'. This new duty will allow action to be taken even if the animal cannot be shown to be suffering at the time.

The Bill applies to all vertebrates - not just domesticated animals - and its powers regarding cruelty offences extend to the protection of wild animals, where they have come under the control of man. Where a person takes responsibility for a wild animal (for example, where it is housed in a sanctuary for a period of time), that animal may also be protected by the Bill's welfare offence.



The new Animal Welfare Bill adds to the law on badger baiting.

Nida Al Fulaij

In particular the Bill includes new legislation relating to the use of animals for fighting, and this will add to the law on badger baiting, the practice of setting up fights between badgers and dogs for human entertainment. Currently, the main legislation protecting badgers in England and Wales is the Protection of Badgers Act 1992. Badgers are also protected under the Protection of Animals Act 1911, Schedule 6 of the Wildlife and Countryside Act 1981 and the Wild Mammals Protection Act 1996. Offences committed under these Acts bring a maximum penalty of 6 months' imprisonment and/or a fine not exceeding Level 5 on the Standard Scale (currently £5,000). The Animal Welfare Bill proposes penalties of up to 51 weeks' 'custody plus' (a short term of imprisonment combined with a licence period (not in prison)) and/or a fine of £20,000 for various offences related to fighting, including aspects of organising and holding fights, showing or distributing videos of fights, keeping or training animals for use in fights, and betting. The Bill has just completed Grand Committee stage in the House of Lords (14 June 2006).

Marine mammals

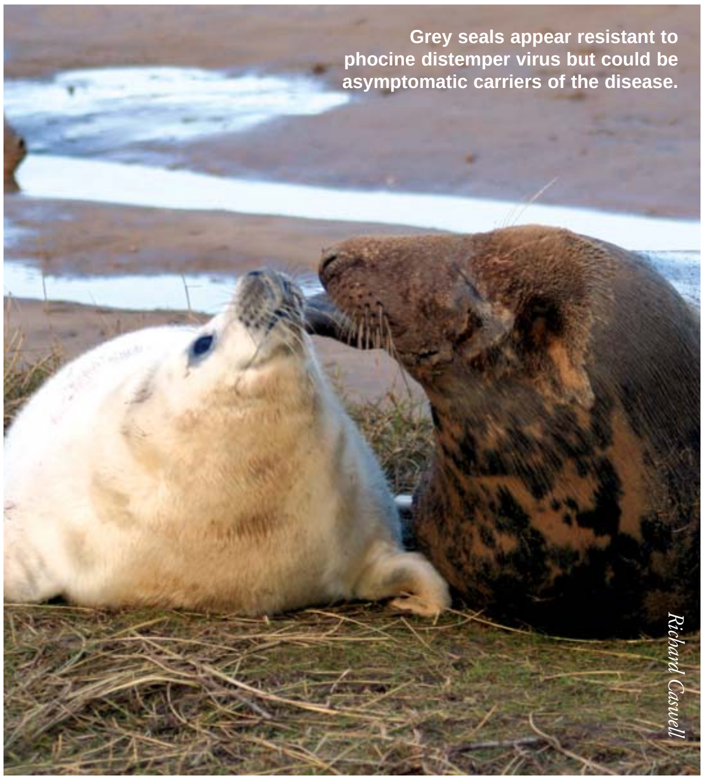



Seals and phocine distemper virus

HARBOUR SEALS AND GREY SEALS are protected throughout England, Wales and Scotland, and adjacent territorial waters, under the Conservation of Seals Act (1970). Although animals are protected from shooting only during the close seasons (September-December for grey seals, and June-August for harbour seals), additional Special Conservation Orders have been invoked, following the severe reductions suffered by some harbour seal populations as a result of phocine distemper outbreaks. The current Orders provide year round protection for harbour seals in parts of England and Scotland to promote the recovery of the populations. Grey seals are also covered to prevent harbour seals being shot as greys. The Conservation of Seals (England) order 1999 provides permanent close season protection for harbour seals and grey seals in an area stretching along the North Sea coast from the English-Scottish border to Newhaven on the south coast – the majority of the English waters they inhabit. The killing, injuring and taking of both species is also prohibited year-round in the Moray Firth under the Conservation of Seals (Scotland) Order 2004.

Outside these Orders, seals can be shot using prescribed firearms and methods during the close season under licence from Defra, the Welsh Assembly Government or the Scottish Executive, where this is necessary to prevent damage to fisheries. In addition, salmon netting stations can shoot seals in the vicinity of fishing nets at any time of year without a licence under the 'netsman's defence'.

Both harbour seals and grey seals are listed in Annexe II of the European Habitats Directive. Signatory states, such as the UK, are required to establish, monitor and protect Special Areas of Conservation (SAC) to ensure favourable conservation status for the species. This affords both species additional protection.



Grey seals appear resistant to phocine distemper virus but could be asymptomatic carriers of the disease.

Richard Caswell

In 1988, phocine distemper virus (PDV) devastated harbour seal populations in northern European and UK coastal waters. Between April and September 1988, more than 15,000 carcasses washed up along the shores of Europe and the UK; this exceeded the regional population estimate at the time[6]. Fourteen years later, in 2002, a second major outbreak occurred, affecting animals in similar geographical locations - both outbreaks were first detected on the Danish island of Anholt. Puzzlingly, however, the PDV epidemic did not spread through the Scottish harbour seal population in 2002, as it had in 1988. The Scottish population contains approximately 86% of the UK's estimated 36,000 harbour seals and therefore probably had sufficient susceptible individuals. Estimated contact rates among infective and susceptible seals, using antibody levels to determine disease exposure, were similar in Scotland and southeastern England, and so it seems that case mortality from PDV may have been highly variable.

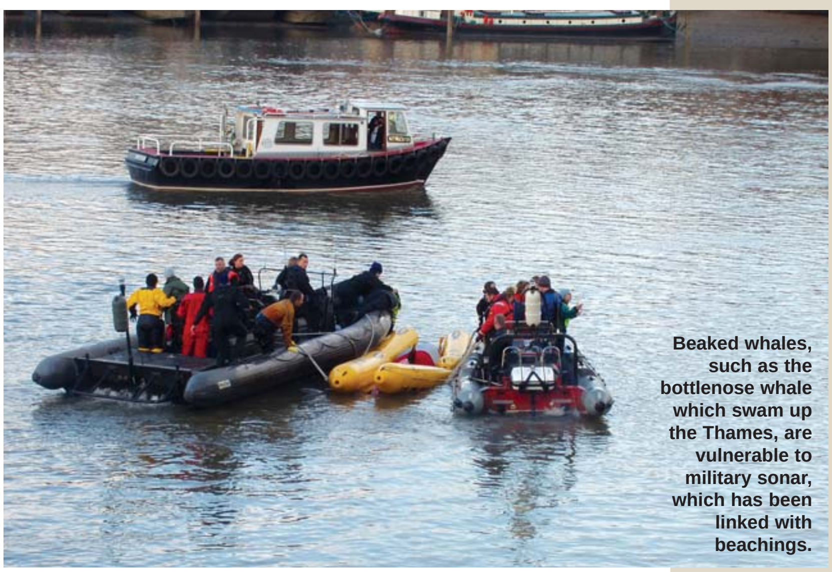
Despite advances in monitoring and epidemiological modelling, key information on contact rates between infective and susceptible host animals is still lacking. More information is required on harbour seal movements, both within and between populations, in order to estimate accurately the rate of disease transmission. Some such data have been gathered using flipper tagging, radio and satellite-telemetry and freeze branding. So far these suggest that while many harbour seals remain in well-defined foraging areas, and return to the same haulout sites, some individuals travel long distances from the coast, to new haulout sites, and the frequency of this behaviour appears to vary with location.

Marine mammals & climate change in UK waters

Increasing sea surface temperatures, together with associated sea level rise and extreme weather conditions, are likely to impact marine fauna in several ways[see 10]. Over the last five years, summer sea surface temperatures have increased steadily in UK waters, partly as a result of the North Atlantic Oscillation (NAO) being in a positive phase, and bringing warm water northwards and deeper into the North Sea. Warm water dolphin species, including the short-beaked common dolphin and the striped dolphin, now occur regularly in the North Sea where formerly they were recorded as vagrants. Warmer waters are also thought to be reducing spawning success in some fish species, such as sand eel and sprat. Reduced availability of fish prey has been blamed for breeding failure among seabirds and may also account for some shifts in the ranges of cetacean predators including minke whale, harbour porpoise and white-beaked dolphin. Although the NAO is due to go into a negative phase, it is not yet known whether global climate change will delay this phenomenon, thereby exacerbating these effects on marine life.

While harbour seals are highly susceptible to infection by PDV, sympatric grey seals are resistant but could be important asymptomatic carriers of the disease[7]. Extremely high PDV antibody prevalence rates in some populations of Arctic seals, including harp and hooded seals, suggest that they are the most likely source of the virus. The sympatric and widely distributed grey seal may transmit the infection between these primary hosts and the harbour seal populations further south. If grey seals travelling between northern Norway and Danish waters are more likely to come into contact with infected harp seals and susceptible harbour seals, this may account for the epidemic point source being Anholt. Whatever the explanation, PDV in UK and other European seals should be considered as a two or three host system. As a result, more information is needed on individual contact rates both within and between sympatric species to enable more accurate estimation of the spread of PDV[8]. One proposed approach for quantifying such a population network structure in seals uses telemetry devices called node-tags[9]. These tags would be deployed on individual seals to record the proximity of other tagged seals within a specified range. When node-tags come into range of one another they would swap and store individual identities, as well as stored encounter histories. These data would then be relayed ashore at intervals through a number of ‘portal’ tags within the network.

Estimating the impact of PDV on harbour seal population dynamics is an important part of the UK’s obligation under the European Habitats Directive. While it is unlikely that a future PDV outbreak could be prevented, predicting the likely impact and spread is important, particularly for developing contingency plans and carcass collection strategies. Risk assessment models that also incorporate interactions with factors such as climate change and environmental contaminants (which have been shown to suppress immunity to PDV in seals), would help identify where efforts to reduce exposure to the disease would be best directed. On a global scale, assessing the risk of infection to threatened or endangered, but currently unexposed, species, such as the Hawaiian monk seal, is essential to determine the efficacy of practical conservation management options, such as vaccination or relocation[8].



Beaked whales, such as the bottlenose whale which swam up the Thames, are vulnerable to military sonar, which has been linked with beachings.

Zoe Greenwood

Military sonar linked to whale beachings

In January 2006 a bottlenose whale swam up the Thames, attracting crowds of onlookers and a fury of international media interest. The group to which this species belongs, the beaked whales, remain the least known and most mysterious of mammals. Nearly half of the species normally termed as ‘whales’ belong to this group of 21 medium-sized cetaceans, and yet some are only known from a few strandings. Research on the behaviour and biology of live beaked whales is just beginning. However, while the reason remains unexplained, it has become clear over the last decade that beaked whales are acutely vulnerable to mid-frequency military sonar, used for hunting submarines. Several strandings of groups of beaked whales (usually Cuvier’s or dense-beaked) have been investigated and a causal link with the use of military sonar has been well established. Researchers have also reviewed records of past mass strandings and military activity, identifying many such events extending back to the 1960s when mid-frequency sonar was first introduced. While the causal link between military sonar and beachings is now universally accepted, the mechanism, and therefore the route to a possible solution, remains unknown. Many potential mechanisms by which intense sound could have such dramatic and lethal effects have been suggested, but a current front-runner, the ‘bubble hypothesis’, has some new and unexpected implications for the animal’s biology. Researchers investigating a series of mass strandings in the Canaries have observed pathologies similar to those of decompression sickness in humans[11]. In particular, oil and gas emboli (obstructions) found in the circulation of beached animals suggest that - either as a result of the direct physical effects of intense sound or, more probably, as an indirect effect of altered behaviour (such as an accelerated ascent rate) - beaked whales get the ‘bends’.

An interesting broader implication of this finding is that beaked whales’ tissues become supersaturated with nitrogen during normal diving behaviour. This demands reassessment of the general assumption that lung collapse and redistribution of circulation normally protect such deep diving species from absorbing high levels of nitrogen. Telemetry work is revealing fascinating details of beaked whales’ extreme diving behaviour - they can reach depths of 2,000m and remain submerged for 90 minutes. However this raises new mysteries because it is difficult to explain such aspects of their diving behaviour in the context of current models of foraging or physiology. None of this yet explains their vulnerability to sonar, nor suggests a solution. Sonar-related deaths among beaked whales are dramatic symptoms of a pervasive problem, the impact of increasing levels of underwater noise on acoustically sensitive marine mammals[12].

Mammal monitoring




THE BRITISH TRUST FOR ORNITHOLOGY and the Mammal Society have recently completed their three-year *Winter Mammal Monitoring* (WMM) pilot survey (2001/02-2003-04)[13]. The Defra-funded project, which involved sightings and field sign surveys for a suite of mammals, aimed to test the feasibility of using volunteers to monitor mammal population trends across the UK. The collection of field sign data on squirrel dreys and deer slots was abandoned because they were non-specific and were difficult to detect and identify. Recording chewed hazelnuts as signs of dormice was also dropped because very few such data were collected in the first year. Hedgehog sightings were omitted because they hibernate for much of the winter. However, the study concluded that WMM could be used to monitor gross trends in certain species and that this should be taken forward as a long-term project. Field sign surveys could detect a 25% increase or decrease in badgers, brown rats, field voles, foxes, moles and rabbits, while sighting surveys could detect a similar change in rabbits, grey squirrels or fallow deer, or a halving or doubling in the number of foxes, brown hares, roe deer, feral cats, and free roaming dogs. The geographical distribution of volunteers and survey uptake resulted in unequal coverage across regions and landscape types, e.g. lowland arable was over-represented while upland, montane and coastal habitats were under-represented, and site turnover rate was high (only 15% and 17% of sites were surveyed in all three years for sightings and signs respectively). The pilot study recommended that the long-term survey should target dedicated long-term volunteers, and expand to cover Northern Ireland to facilitate reporting at the UK level.

The MTUK *Living with Mammals* survey is now in its fourth year. 2005 saw the first recording of Chinese water deer in the survey, and although this species is introduced, the small UK population is internationally important. The 2005 feedback also highlights a problem with simple comparison of species seen in different habitats. This is that: (a) different types of site are unlikely to be observed for comparable periods during the day and night (churchyards, playing fields and railway embankments were surveyed comparatively little at dusk and night when many mammals are most active); and (b) the time of day affects the species seen (grey squirrels were seen more often during the day, and bats and hedgehogs more often at night)[14]. Biases in survey estimates may be inevitable in surveys conducted by volunteers, however these can be controlled for provided all survey times, site types and combinations of the two are adequately represented. One finding reported in the 2005 feedback is that, in the northwest and eastern regions of the UK, 3.5-5 times fewer hedgehogs were seen per survey in 2005 than in 2004. However this did not take into account site type or time of day. While suggested reasons for the reduction in hedgehog sightings were declining numbers and a more typical spring in 2005 than 2004, alternative explanations could be that a greater proportion of surveys in those regions during 2005 was conducted during the day or at site types less suitable for hedgehogs.

The water shrew is the least well known of Britain's riparian mammals. Localised studies have suggested that they have decreased in number and occurrence in areas where they were formerly abundant. However the Mammal Society's recent national *Water Shrew Survey* has revealed them to be widely distributed with a concentration in central and eastern England[15]. Between April 2004 and September 2005, volunteer surveyors collected putative water shrew scats using bait tubes. These were sent to the Mammal Society and King's College, London, for compositional analysis. Water shrew scats can be reliably identified from the remains of aquatic invertebrate prey, and were found at 17% (387/2,159) of sites. Habitat information gathered by volunteers revealed that water shrews could exploit a range of riparian habitats. Previous knowledge suggested that they preferred fast-flowing water, but the species was also found in a high proportion of slow moving and standing water habitats, e.g. ditches, canals, ponds and lakes. Previous records from such habitats are scarce. The report recommends that riparian habitats should be managed sensitively until their population size and conservation needs can be established.

Roe deer are predicted to expand to 79% of Britain by 2012.

Dave Bevan

Water shrews appear to be widely distributed, but riparian habitats should be managed sensitively until more is known of their conservation needs.

Terry Whittaker

The spread of wild deer across Britain

All six species of free-ranging deer in Britain have expanded their national ranges over the past 30 years. Between 1972 and 2002, deer ranges expanded by an estimated compound annual rate of between 0.3% (red deer) and 8.2% (Reeves' muntjac). Between 1972 and 2002, most species' ranges expanded by approximately 2% (fallow deer, 1.8%; Chinese water deer, 2.0%; roe deer, 2.3%), with Japanese sika expanding their range by 5.3% per annum. This pattern of spread is likely to continue for the foreseeable future, with roe deer (which were present across 31% of Britain in 1972) predicted to have expanded to 79% of the country by 2012[16]. Game Conservancy Trust National Game Bag records exhibit increasing trends and expanding distributions for roe, fallow, red and muntjac bags, and an increasing trend for Sika[17].

In many cases the distribution and spread of deer have resulted from introductions and translocations by man. For example, during the 19th century, roe deer were reintroduced into parts of England from Germany and Scotland. Current fallow deer distribution reflects the pattern of deer parks from which many wild populations arose. People have clearly facilitated the spread of muntjac, and some neighbouring populations are relatively distantly related following illegal translocations. However, increased planting of favourable habitats, such as woodlands, and an increasingly milder climate are probably also encouraging the spread of deer across Britain.

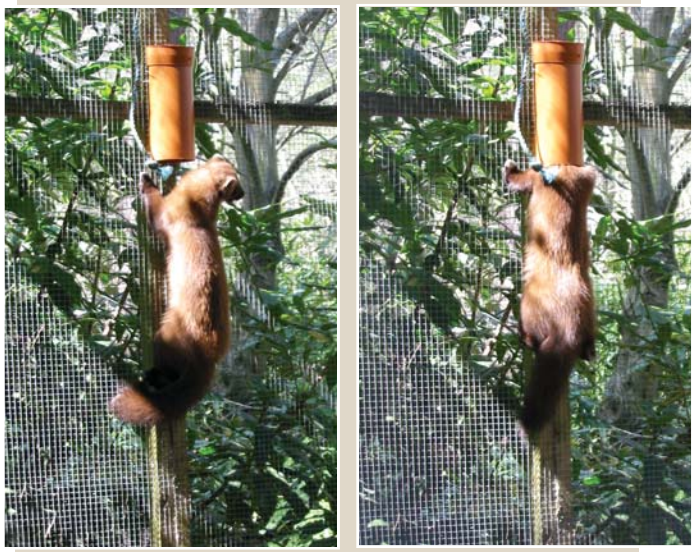
The substantial expansion of roe deer distribution, and maintenance of the red deer's range (both native species), are considered by some to represent a considerable conservation success. However, deer of all species can damage forestry and agricultural crops, and highly abundant deer populations may degrade ground flora and associated faunal communities of conservation importance. Expansion of Japanese sika into red deer range (estimated overlap has increased from 7% to 36% in 30 years) increases the chances of further hybridisation between these species, resulting in genetic introgression of both, and consequent reduction in putative native biodiversity. Deer and their habitats should be managed carefully, and with regard for animal welfare, to ensure that wild deer populations are a beneficial component of Britain's biodiversity[16].

Monitoring innovations

Pine marten hair tubes

Waterford Institute of Technology has developed an effective pine marten hair tube for collecting DNA samples for conducting population surveys. The tubes are made from standard PVC sewer pipe, are easier to make and lighter than previous designs, and cost about €5 each. Because the tubes pack in pairs, and weigh just 400g each, one person can carry enough to set up surveys. Current trials in southeast Ireland indicate higher success rates than with previous designs. The adhesive used (from mouse glue traps; Solway Feeders, Dundrennan, Scotland) normally yields samples of more than 30 hairs, many with follicles, which provide better DNA. DNA analysis is conducted using Real Time PCR to determine species and sex; the combination of sensitive fluorescent dyes and automation renders the analysis more reliable and rapid than conventional PCR (up to 80 hair samples/day). Further DNA analysis can distinguish individuals, thus yielding information on population size and behaviour.

Peter Turner



New hair tubes have been designed to gather DNA samples for surveying pine martens.

Examining ecology using isotopes

The stable isotopes (atoms of the same chemical element but different mass) comprising animal tissue reflect their spatial and feeding behaviour. For example, ratios of stable carbon isotopes reflect the extent of feeding in marine and terrestrial habitats, while stable nitrogen signatures indicate trophic level. Isotope analysis has been applied successfully to birds[18], and is being pioneered for British mammals at Quercus, Queen's University Belfast. The isotopic signatures of bat wing membranes are being analysed to examine how bats partition feeding resources, and fox whiskers are being analysed to determine how their foraging ecology affects the risk of exposure to environmental contaminants. Together with the Central Science Laboratory, Quercus have also examined mink whiskers to evaluate mink eradication in the Outer Hebrides and suggest potential ways of enhancing eradication efficacy. This technique holds significant potential to bring new insights into mammal ecology and conservation.

The impact of otters on mink

THE ESTABLISHMENT AND SPREAD of invasive species is one of the greatest threats to biodiversity. The American mink, a semi-aquatic mustelid, is a native of North America, but was introduced to the UK early in the twentieth century to supply the fur farming industry. The first feral populations of mink were observed in the 1950s. Between 1950 and the mid-1980s, mink numbers increased and their population ranges expanded. From the mid 1970s onwards, American mink populations have been monitored in Britain as part of a series of national otter surveys and water vole surveys by the Vincent Wildlife Trust, Environment Agency, Wildlife Trusts, Nature Conservancy Council and Scottish Natural Heritage. These surveys revealed that since the mid-1980s and early-1990s, respectively, there has been a widespread decline in the number of sites occupied by mink in England. The intriguing question was *what had caused this decline?* The answer has important conservation implications because, if the cause of the decline can be understood, then it should be possible to make better predictions about the fate of those native species affected by mink, and to design more effective conservation strategies for them.

A number of hypotheses on the causes of mink decline can be largely discounted. For example, increased trapping by gamekeepers was unlikely to have been a widespread cause of the decline of mink, because the number of gamekeepers in Britain has decreased significantly over the last century (23,056 in 1911 to about 3,000 in 2002). There is no evidence that prey or pollution have caused the decline in mink; indeed both otters and polecats (which might be expected to be affected in a similar way) have increased in numbers. It is unlikely that the decline in the number of mink farms has been a driving factor because there has been no temporal and spatial correlation between feral mink abundance and farm presence[19]. And there is no evidence that mink have been impacted by disease at a sufficiently widespread level, however this possibility warrants further investigation.

Recovering otter populations may be contributing to declines in mink numbers.

One possible factor in mink decline is an increase in potential competitors. American mink, European otters and European polecats occupy similar niches and can potentially compete with one another for food or other resources. Over the past couple of decades, otters and polecats, both native mustelids, have begun dramatic recoveries in their distributions and abundance after long periods of decline. However, research by the WildCRU, University of Oxford, found no relationship between the increase in polecats and decline in mink on English rivers[19]. In fact, mink declined in many areas from which polecats were absent, such as the southwest and northeast of England. This suggests that polecats were unlikely to have caused the widespread decline of occupied mink sites in England, although their presence might act to accelerate the decline where they co-exist. In contrast, however, the WildCRU study did find a significant relationship between the decline in mink signs and the increase in those of otters, suggesting that returning otters may be driving the reduction of mink signs[19]. This is further supported because: (a) the mink decline occurred mostly in western and northern England, where otter populations have recently reached considerable densities; and (b) mink signs continue to increase at sites in eastern and southern England, where otters currently remain scarce. There is particular potential for competition between otters and mink, because they are both semi-aquatic. Furthermore, inter-specific competition among carnivores, such as these, often involves direct aggression and may therefore have particularly powerful effects.

There is further evidence that otters have a negative impact on mink. In 1999, The Otter Trust released 17 otters into the Upper Thames, where there was an established population of mink but otters were practically absent. Mink signs declined significantly in the area following the reintroduction of otters, while a population of mink in a contiguous area, not occupied by otters, appeared to remain approximately stable[20].

The exact mechanism by which otters impact mink is not yet clear. However, mink are known to change their diet in the presence of otters - concentrating more on terrestrial rather than aquatic prey - possibly to avoid competition[21]. This may be the means by which mink and otters tend to coexist for longer in areas with greater abundance of terrestrial prey[22].

A decline in the English population of invasive American mink would be welcomed by those concerned with the protection of native species, and in particular the highly endangered water vole. Water voles have been disappearing rapidly in Britain over the past few decades as a result of habitat loss and mink predation; now they are at risk of national extinction. It remains to be seen whether otters will disturb mink sufficiently to allow water vole populations to recover without further human intervention.

The mink control model

Problem animal control and eradication campaigns may be costly financially and in terms of animal welfare and human effort. The success of such endeavours varies widely, ranging from satisfactory to disappointing[23]. It is therefore vital that control campaigns are planned carefully, and their likelihood of success assessed, before control work begins. Together, the University of Newcastle and the WildCRU, University of Oxford (funded by the Esmee Fairbairn Foundation and MTUK), have produced a computer model that identifies key criteria for developing mink control strategies. The model takes into account immigration by mink, an important factor in their population dynamics on the mainland. The model also incorporates ecological aspects of one of the mink's prey species – the water vole, a UK BAP species - to examine which control strategy might best promote its long-term survival. The model highlighted a number of practical points regarding the targeting of mink trapping. For example, it revealed that the success of a trapping regime, which obviously depends on the likelihood of mink entering traps, can be affected by habitat type, the density of mink, and the efficiency of the particular trapper. The model also established that, while minimum mink density may be maintained by trapping during certain phases of the mink annual cycle, a different trapping regime would be required to ensure viable water vole populations. This suggests that the optimal trapping strategy for protecting species of conservation concern, such as the water vole, may not be the best for other species, raising issues about potentially opposing priorities. In this sense the model provides a tool for considering scenarios that would otherwise require long and costly field studies, and potentially adverse effects for conservation in the meantime.

Tony Margiocchi

Controlling mink to conserve water voles

The UK water vole population is threatened by habitat loss and predation by American mink. In most UK habitats, except large wetlands, mink can very quickly remove water voles. For example, on the Wendover Canal, Buckinghamshire, all but one of 120 water voles were lost to mink predation between September 2001 and April 2002. Mink control, at least locally, is likely to be necessary to ensure the survival of water vole populations in many areas. Recent advances, such as the development of the Game Conservancy Trust's mink raft (featured in last year's report[24]) have improved the detectability and trappability of mink, and large-scale trials suggest that mink control over large areas is possible. Between 2003 and 2006, a mink-control campaign in southwest England removed 260 mink, and water voles were subsequently recorded in areas from which they had been lost. Similar projects are underway in East Anglia, Yorkshire, southeast England, north Wales and the Cairngorms. The ideal is that mink can be removed from sufficiently large areas that control efforts can be reduced to a 'cordon sanitaire' across likely invasion routes. The UK Water Vole Steering Group has endorsed a national plan involving the humane control of mink. In order to be ethically supportable, mink control efforts aimed at conserving water voles should do so effectively. Since all current mink control programmes concern defensible areas of land with extant water vole populations, the potential benefits for water voles are large.

The reproductive biology of American mink

Outside the breeding season, American mink defend intra-sexual territories, with a single male territory overlapping several female territories; this spatial arrangement is typical among most mustelids. Mink breed annually and, in Britain, mating occurs between late February and early April. There is a short delay, embryonic diapause, between fertilisation and implantation, during which females continue to ovulate, and kits may be sired by multiple males fertilising ova from different ovulations[25]. Five to eight kits, potentially with different fathers, are born between late April and mid May. This conception during pregnancy is called superfoetation. The combination of embryonic diapause and superfoetation, which allows females to mate with multiple males (polyandry), may increase female reproductive fitness, and cause paternity uncertainty among males, thereby reducing the likelihood of infanticide. Paternity uncertainty may also play a role in males abandoning territoriality and roaming widely during the breeding season. This behaviour is contrary to the widely accepted view that territorial defence is important for male reproductive success among carnivores. Embryonic diapause and superfoetation may however occur in other mustelids, in which case the sociobiology of mustelids would need re-evaluation. American mink may present a good model species for studying sexual conflict in reproduction among placental mammals.




Badger repellents

TRADITIONALLY, WILDLIFE MANAGERS have killed animals seen as pests, and although this may be effective at reducing damage locally, and in the short-term, this is not always the case. Rapid replacement of culled animals through immigration or density-dependent responses, such as increased birth or survival rate, can render culling little more than a sustainable harvest. At the other extreme, some culling endeavours have driven native British species to extinction, e.g. bears, wolves, lynx, and more recently, in the 19th century, resulted in the widespread extirpation of polecats, wildcats, and pine martens from much or all of England and Wales. Non-lethal alternatives to culling could bring a variety of advantages in terms of conservation, ethics, effectiveness and the law, and there are increasing demands for non-lethal methods of resolving foraging conflict between people and a range of wildlife species.

Badgers epitomise a set of circumstances driving research into non-lethal control. British farmers commonly cite them as agricultural pests, and badgers are opportunistic omnivores, numerous in England and Wales, where they cause an estimated £6.5-12.5 million of direct damage per annum to crops such as maize and wheat[26]. However, badgers are heavily protected by legislation designed primarily to prevent badger baiting and, despite being disliked by sections of the rural community, they remain extremely popular with the public. Under The Protection of Badgers Act 1992, it is illegal to kill, injure or take a badger without a licence from Defra or English Nature. The Control of Pesticides Regulations 1986 prohibit the use of unapproved products to deter or kill animals, including badgers. In 2005, approval was withdrawn for Renardine™, a bone-oil-based product marketed for use with badgers. No chemical repellents are approved for specific use with badgers.

Researchers at the WildCRU (University of Oxford) have been working to develop feeding repellents for use with wild badgers, under experimental approval from the Pesticide Safety Directorate. Initially they screened a suite of potential odour repellents including wolf dung, stoat odour, and human body odour, but none deterred badger feeding on target foods. However, when they tested a range of food-based repellents they hit on success[27]. Free-ranging badgers were presented with a choice of baits treated with three different food-based repellents – cinnamamide (cinnamon extract), capsaicin (chilli pepper) and ziram (a fungicide). Although they preferred untreated baits, and ate them first, they always also ate all baits treated with cinnamamide and capsaicin. However, ziram was least preferred, and after 7-9 nights badgers stopped eating ziram baits abruptly – and ziram baits remained virtually untouched for the final 20 nights of the study. Because the researchers videoed their trials, they were able to examine the detailed behavioural mechanisms underlying their findings. They discovered that badgers were more likely to reject ziram baits, than others, after sampling or tasting them, and that the rejection of all repellent-treated baits increased sharply to a peak around the seventh treatment night – around the same time that badgers stopped eating ziram baits. These findings led the researchers to conclude that badgers had acquired a Conditioned Taste Aversion (CTA) to ziram-treated baits.

CTA is a type of learned food aversion that has evolved in many taxa, and which assists animals in avoiding being poisoned. CTA develops when an animal ingests a food that makes it nauseous, or unwell, and it forms a subconscious association between the taste of that food and the illness; the animal subsequently avoids the taste of that food as a result. Further examination of behavioural footage from the WildCRU study revealed that once badgers had stopped eating ziram baits, their pattern of behaviour on each treatment night was to eat all untreated baits, followed by all capsaicin and cinnamamide baits, and then to make return visits to the feeding site but apparently ignoring the intact ziram baits[27]. Similar behaviour has been observed among raccoons with CTA towards eggs. This observation that badgers seemingly avoided ziram baits without tasting them however suggested that a more sophisticated mechanism was at work, perhaps involving 'second order' conditioning to odour cues. Food aversions are more readily associated with taste than with non-taste cues and second order conditioning involves an animal first developing an aversion to a particular food taste, and then forming an association between the aversive taste and an odour (or other non-taste cue). CTA has been explored as a potential wildlife management tool with a number of species. However a limitation of using a classic taste aversion to protect target foods is that animals would need to taste (and therefore very likely damage) a food before being averted by its taste. The important question inspired by the results of the WildCRU study was whether badgers might instead be persuaded to avoid damaging untreated foods on the basis of an odour cue.

Learned food aversions involving odour cues might potentially be used to manage badger feeding behaviour.

The team tested this possibility by examining the role of an odour cue in learned food aversions with badgers[28]. In their previous study, they had used a formulation of ziram known as Aaprotect™, which has an odour acquired during the formulation process.

Dave Bevan

However, the active ingredient ziram is thought to be odourless. For their next study, the researchers used odourless ziram and a novel odour cue, clove oil, so that they could test the role of taste and odour separately. The team concluded that badgers trained with a combination of ziram and clove oil learned to associate the odour with unpalatable ziram-treated baits and subsequently avoided untreated baits in the presence of clove odour[28]. However, badgers trained with ziram on its own did not then avoid untreated baits, and those trained with clove on its own did not avoid untreated baits in the presence of clove odour.

This research has demonstrated that learned food aversions might be developed for managing feeding behaviour by badgers, and that odour cues might prove useful tools. However trials would need to be repeated on a large scale before progressing to full-scale field studies, and this kind of work is very expensive. For the time being, at least, electric fencing might be the best way to reduce badger damage to small areas such as gardens.

Bat-wind farm collisions

Several studies have reported bird collisions with wind turbines placed along traditional migratory routes. Recently it has become apparent that bats are substantially more vulnerable than birds to collisions with turbines[29]. While the underlying reasons remain unclear, thermal imaging data suggest that bats are attracted to, and investigate, moving and static turbine blades. In a recent study at two wind farms in the USA, fatalities were most frequent during migration, with 700-2,000 fatalities occurring in a 6 week period[29]. Migratory species comprise the majority of casualties, and this is exacerbated by turbines being placed along migration routes, such as ridges and forest corridors.

Bat-turbine mortality surveys are in their infancy in Europe. However, 15 of the 35 European bat species are regular victims of turbine collisions, and an Intersessional Working Group of UNEP/EUROBATS listed 20 species as at risk of collision because of their ecology[30]. Currently, researchers in Europe are working to produce credible mortality estimates. Research also needs to investigate the underlying reasons for bat-turbine collisions and potential methods of mitigation. The University of Aberdeen is testing the hypothesis that bats avoid the electromagnetic radiation produced by airport radars, and the possibility that radiation sources fitted to wind turbines might reduce bat-turbine collisions.

Hedgehogs held in captivity for longer periods may be better equipped for translocation.

Stephen Oliver

Reducing Deer-Vehicle Collisions

Roadside reflectors designed to alert deer to traffic, by reflecting car headlights towards the verge, are widely used in Britain. However, most research suggests that they do not reduce deer-vehicle collisions (DVCs) in the long-term. Two more sophisticated roadside deterrents, incorporating acoustic and visual signals, are now available (Acoustic Wildlife Reflectors (Wegu-gft; Germany) and Ecopillars (Eurocontor; Slovenia))[31]. Both are triggered by the headlights and/or vibration from on-coming traffic, and are solar-powered, recharging during the day. When activated, Acoustic Reflectors emit a high pitched whistle, whereas Ecopillars emit a range of low frequency and ultrasonic signals, deer potentially habituating less readily to the variable signals. Jochen Langbein, of the Deer Collisions Project, is testing these devices at DVC black spots in Somerset, Hertfordshire and Devon (funded by local county councils and The Highways Agency). Diurnal and nocturnal digital video surveillance are used to monitor whether deer and other wildlife delay crossing for longer after traffic has passed where the devices are present, and whether responses differ between deer species.

Another innovative measure, interactive signs triggered by deer close to the road and/or driver speed, was deployed in Britain (Ashridge Forest) for the first time this year (funded by Hertfordshire Highways). Two laser beams set parallel to the road at a DVC black spot detect large animals moving onto the verge, and trigger digital signs to flash an image of a deer and 'slow down' message to warn drivers. The signs also display a 50 mph speed restriction whenever approaching traffic exceeds that speed limit[31].

Jochen Langbein

Eco-pillars are designed to deter deer from crossing roads using acoustic signals and optical flashes.

Hedgehog translocations

Translocation is often used as a tool for the conservation and management of wildlife, and in the release of rehabilitated animals. However translocation strategies are seldom tested and improved protocols could have significant benefits for conservation and animal welfare. A recent study by the University of Bristol examined the effects of translocation on post-release survival and behaviour among hedgehogs[32]. Wild individuals held in captivity for more than a month prior to translocation had a better survival rate than hedgehogs translocated after fewer than 6 days in captivity. The study concluded that animals kept in captivity for the longer period were better equipped to cope with release because they had built up fat reserves and become accustomed to the stress associated with manipulation while in captivity.

Reintroducing extinct mammals




WILD BOAR, EURASIAN BEAVERS AND EURASIAN LYNX were formerly native to Britain and their reinstatement as part of our native fauna is a high profile issue. Wild boar were driven to extinction in Britain between the 13th and 17th centuries. Recently, however, several small breeding populations have become established in parts of England, following escapes from boar farms first introduced in the 1980s. Such farms continue to spring up to supply the meat trade and escapees are reported regularly. Three main breeding populations exist in southern England, the largest in Kent and East Sussex and the others in west Dorset and Herefordshire, but feral individuals are reported much more widely and some may also be breeding. Almost without exception the feral boar have the 'pure' wild-type appearance and the Sussex population, at least, is no less 'pure' genetically than naturally occurring boar populations in Western Europe[33]. Currently several hundred boar are estimated to be roaming free in Britain, but they are not spreading as quickly as might be expected given their large reproductive capacity. Research on boar ranging behaviour, conducted by the Central Science Laboratory (CSL), demonstrated that most individuals neither ranged nor dispersed far, and movements were closely associated with dense woodland cover[33]. Expansion of their range may have been restricted further by local landowners controlling feral populations hard; most of the individuals trapped in the CSL study were dead within a year. As well as escapes there have been several deliberate releases. In December 2005, animal rights activists released more than 100 animals from a boar farm in Devon (a second release occurred several months later). Most of the animals were rounded up, or returned of their own accord, but around 20 were shot, several died in road accidents and some were still at large several months later. There is evidence that boar have also been released with the aim of establishing feral populations, for example, in 2004 more than 30 extremely tame animals appeared suddenly in the Forest of Dean.

Researchers are examining the use of pigs (in the role of wild boar) for restoring habitat on the Alladale Estate, Northern Highlands.

In 2005, following several years of research on the distribution, breeding biology, ranging behaviour and genetics of feral boar, Defra initiated a public consultation on wild boar in Britain. This elicited about 250 responses representing a wide range of views, which were summarised and published in May 2006[34]. The majority of respondents (80%) recognised the need for some form of management by government, and eradication was the most preferred management option, with 44% support. Overall though, the majority of respondents did not want to see feral boar populations eradicated. Defra will publish their response to the consultation exercise by the beginning of 2007.

Britain's island status may present a uniquely secure refuge for beavers.

Eurasian beavers once ranged throughout Northern Eurasia, from the UK and Spain to Eastern Siberia and Mongolia. Beavers were hunted to extinction in Britain in the 16th century, and by the beginning of the 20th century they were almost eradicated from their former European range, with just 1,200 individuals surviving in eight populations. Since the 1920s, beavers have been reintroduced to an estimated 26 European countries outside Britain including, since 1999, Denmark, Luxembourg, Slovenia, Belgium and Spain. The wild population is now estimated to consist of at least 639,000 animals, and Eurasian beavers are currently classified as Near Threatened by the IUCN. One potential threat is the expansion of invasive North American beaver populations, as is happening in Finland. Britain's island status may therefore present a uniquely secure refuge for the species in the future.

At least five enclosed beaver releases have taken place in Britain, two in Scotland and three in England, the largest at Ham Fen, Kent, and the Cotswold Water Park, Gloucestershire; as a result, there are currently 10-20 'semi-wild' beavers in Britain. No beaver reintroductions have been conducted in Britain, although Scottish Natural Heritage (SNH), with support from MTUK, did propose a trial reintroduction for Scotland. In 1998, SNH conducted a public consultation exercise on reintroducing beavers to Scotland and, although the majority of the public were in favour, certain interest groups raised concerns. SNH applied for a licence to undertake a trial reintroduction at Knapdale, Argyll, but in 2005 the Scottish Executive refused the application, citing a number of concerns, including the potential impacts on a Natura site[35]. However their dam-building activity might aid water catchment management[36], and German fishermen have apparently welcomed beavers because the pools they create have increased fish densities by 80%. Beavers in Germany have reportedly also proved effective at creating new habitats and increasing species richness, encouraging the return of otters, kingfishers and dragonflies[37].

Until recently the Eurasian lynx was thought to have become extinct as a result of climate change around 4,000 years ago. However, new research by a team of ecologists and palaeontologists has confirmed that lynx survived in Britain until relatively recently, most likely dying out as a result of anthropogenic factors such as deforestation, declining deer populations and persecution[38]. Radiocarbon dating of bone from caves in North Yorkshire showed that lynx still roamed that area in the 6th century AD, while cultural evidence suggests they inhabited the Lake District and Scottish Highlands into later medieval times. The Eurasian lynx is listed on Annex IV of the EU Habitats Directive as a species whose reintroduction should be considered by member states. The recently identified human involvement in its demise strengthens the case for reintroducing lynx in Britain.

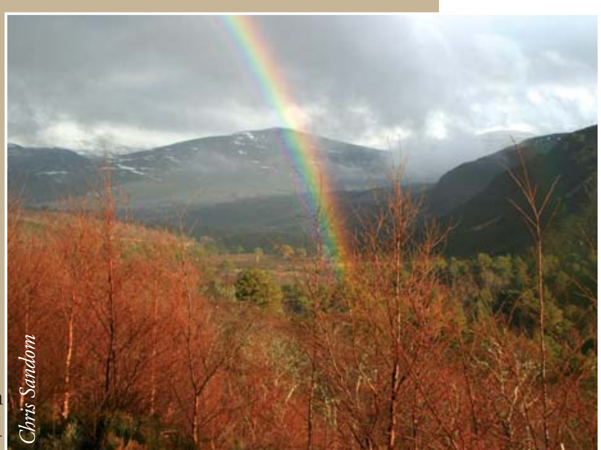
Other research shows that the extensive, well-connected Scottish forests, with their abundant deer populations, could support several hundred lynx[39]. Lynx would most likely hunt roe, sika and juvenile red deer, supplementing their diet with hares and foxes. As in Switzerland, lynx might disperse concentrations of deer, thereby relieving grazing and browsing pressure in some areas. Their preference for dense cover suggests they would be unlikely to predate grouse on open grouse moors. Of the three large carnivores once found in Britain (lynx, bears and wolves), the lynx would probably be the easiest for humans to live alongside. Lynx attacks on sheep would probably be small-scale and localised, as in continental Europe. Modest governmental spending on preventative measures in Switzerland has seen the number of sheep killed by lynx decline sharply from 198 in 2000 to just 35 in 2005[40].

Recently identified human involvement in the demise of the lynx in Britain strengthens the case for reintroducing the species.

Alladale Wilderness Reserve

The beautiful Alladale Estate, in the remote Northern Highlands, has been managed as a traditional sporting estate for over a century. However, in 2003, the estate changed hands and the new owner, Paul Lister, now plans to manage Alladale for large-scale conservation interests[41]. The aim is to restore elements of the ecosystem that have been lost through habitat loss and persecution by man, including several once native predators, such as the grey wolf, brown bear and Eurasian lynx. However, the plan has been widely misreported as involving the imminent reintroduction of large predators to the wild, whereas in reality the proposal is a long-term aim to create a fenced wilderness area (20,234ha - equivalent to 50,000 acres), loosely analogous to the fenced reserves established successfully in South Africa. In these semi-natural circumstances some natural processes (such as predation) could occur whereas others (such as unrestricted dispersal) clearly could not.

More immediately, three conservation activities are already in operation: planting Caledonian pine, deer control, and the Alladale Science Programme, run in collaboration with the WildCRU, University of Oxford. The latter has begun with a three-year exploration of the use of ungulates, principally pigs (in the role of wild boar) but also red deer and European elk as tools in habitat restoration through reducing bracken (and monitoring tick populations) within carefully monitored enclosures.



Disease in wild mammals




IN MAY 2005, MTUK SPONSORED A THINK TANK on the links between infectious disease and mammalian conservation, and the resulting special issue of the journal *Biological Conservation* was published in August 2006[42].

Wildlife and bovine tuberculosis

Since the 1970s, British badgers have been subject to Government culling programmes aimed at reducing transmission of bovine tuberculosis (bTB) to cattle. Nevertheless, incidence of bTB in cattle has increased steadily over the last 30 years, and is currently rising at 18% p.a. Various hypotheses have been proposed to explain this failure of control, two of which concern wildlife. The first, that wild mammal species other than badgers are important in bTB transmission, can be largely refuted. Linked projects by WildCRU (University of Oxford) and Central Science Laboratory (CSL) have demonstrated that while some species may carry bTB, prevalence is likely to be very low in most non-badger farmland wildlife species, with the possible exception of deer[43,44]. The researchers concluded that if any wildlife species plays a significant role in the epidemiology of bTB in cattle, it is likely to be badgers[45]. The second hypothesis is that a perturbation effect among badgers surviving a cull countermands the hoped-for reduction in bTB transmission to cattle, or even increases it. Research conducted by WildCRU and CSL demonstrated that badger culls disturb the behavioural ecology of survivors, and there is evidence that perturbation increases incidence of bTB in badgers, especially in groups close to those that are removed[45]. These findings support those of the Government's Randomised Badger Culling Trial (RBCT), which found that while culling reduced cattle bTB in culled areas, incidence increased in adjoining areas[46]. Perturbation effects provide one possible explanation of the failure of badger control as a means of reducing bTB in cattle, and may provide an explanation for why prevalence in both badgers and cattle has increased. Other factors might include cattle-cattle transmission, farm management and disease surveillance[45]. In March 2006, the Government introduced new rules regarding the pre-movement testing of cattle for bTB; meanwhile they are considering their response to a public consultation on the culling of badgers for the control of bTB.

Writing to the Guardian newspaper on 10th March 2006, the President and Vice Presidents of the Wildlife Trusts (Professor Aubrey Manning, Sir David Attenborough, Professor David Macdonald) concluded that the scientific evidence is that a badger cull would be unhelpful[47].

"The Wildlife Trusts understand the importance of farming to the economy and the maintenance of a biodiverse countryside. The Trusts appreciate how serious bovine TB is to cattle farmers and the difficulty Defra faces in managing it, as highlighted by Ben Bradshaw (Guardian Letters, March 9); and recognise that in some areas badgers play a part in transmitting the disease to cattle. However, the evidence is that proposals to introduce badger culling would not help.

Scientific investigations have shown unequivocally that unless culling is to be carried out over areas of at least several hundred square kilometres, and in ways that are more effective than proven possible in past culls, there will at best be little benefit. This is due to the demonstrated increase in cattle TB incidence at the edges of control areas and the likelihood of similar counter-productive effects within culled areas wherever there are gaps or inefficiencies. The likely reason for this is "perturbation" - or changes in the movements, social behaviour and possibly immunity of surviving badgers.

Any badger cull carried out in a similar way to its predecessors is unlikely to decrease significantly the incidence of TB in cattle, and may make it worse - this at a great cost financially, in public discord and to badgers. To achieve a better result would require an approach that avoided gaps (due, for example, to lack of compliance), adopted a killing method acceptable on welfare grounds to the public, would not be compromised by the interventions of objectors, and which could be implemented and coordinated over very large areas. It would also need an open-ended commitment until a (perturbation-free) exit strategy allowed it to be replaced by an as yet unknown alternative solution.

In contrast to these unpromising prospects for a badger cull, it is well established that the main source of infection in cattle is from other cattle. Hence cattle-movement controls, improved surveillance and cattle testing, vaccine development, and improvements in biosecurity, animal husbandry and farmland management offer promising prospects for reducing the transmission and spread of the disease. The government's introduction of pre-movement testing is welcome. However, if evaluation of these options were muddled up with a simultaneous badger cull, the results would be uninterpretable.

Wildlife management should be based on evidence, and scientific evaluation of likely outcomes (including a full analysis of the costs and benefits of different interventions). The evidence is that a badger cull on a scale or level of efficiency that seems feasible will not solve the cattle farmers' problem - that problem is truly serious. Understandably, the feeling is that something must be done, but the evidence is that it should not be a badger cull."

Scientific evidence suggests that culling badgers will not resolve the problem of bTB in cattle.

Rabies in bats

Bats may carry, or become infected by, a number of viral diseases, including several strains of rabies (genus Lyssavirus). All Lyssavirus genotypes may cause rabies, and those so far recorded in bats in various parts of the world include classical rabies virus (RABV), Lagos bat virus (LBV), Duvenhage virus (DUVV), European bat viruses (EBLV-1 and EBLV-2) and Australian bat virus (ABLV). Four other Lyssaviruses isolated from bats are awaiting classification[48].

EBLVs were first documented in Europe in 1954. Between 1977 and 2004, 783 cases were recorded in European bats, using isolation of viral RNA; EBLV infection was identified in 12 bat species, with over 95% of EBLV-1 infections occurring in the serotine bat, and all 16 cases of EBLV-2 identified in bats found in either Daubenton's or pond bats[49]. Between 1987 and 2004, passive surveillance in the UK has tested 4,873 bats for lyssaviruses, and four Daubenton's bats tested positive for EBLV-2. Active surveillance in the UK (2003-2005) has detected EBLV-1 antibody prevalence levels between 0.01-2.85% in serotine bats (153 tested) and those for EBLV-2 between 0.05-4.2% in Daubenton's bats (349 tested). No cases of live lyssavirus infection or lyssavirus viral RNA have yet been detected through active surveillance[49]. There has been one confirmed human case of EBLV-1 (in Russia), two of EBLV-2 (in Scotland and Finland); EBLV-1 has also been found in sheep and one stone marten. Further research and monitoring regarding prevalence, transmission, pathogenesis and immunity are required to ensure that integrated bat conservation continues throughout Europe, while enabling informed policy-making regarding human and wildlife health issues[50].

Water vole health screening

Water vole numbers in Britain have declined largely through habitat fragmentation and predation by American mink. However other factors, such as disease, may exacerbate the loss of remnant populations. Parasites and pathogens can affect individual survival and fecundity, and are integral to any wild population; the WildCRU is investigating which are naturally present in wild water vole populations. Pathogens so far identified include *Giardia* and *Cryptosporidium* spp., both emerging infectious diseases in humans. Others isolated at very low prevalence include *Mycobacterium bovis* (bovine tuberculosis), *Yersinia enterocolitica* and *Listeria* spp[51]. This study aims to examine how disease might affect the success of release programmes in order to inform better management of disease risks associated with reintroductions or translocations. Ideally, animals destined for release should be reasonably free from disease, and able to withstand pathogens present at the release site. Before proceeding with a release programme, with a particular species, it is therefore desirable to conduct health screening of extant populations to establish baseline disease information. Once armed with this information, researchers can conduct health surveillance of animals, both prior to release and ideally for at least one follow-up session post release, to establish fitness of the reintroduced population.

Squirrel poxvirus

Squirrel poxvirus (SQPV) provides an example of pathogen-mediated competition between an invasive species, the grey squirrel, and the native Eurasian red squirrel. SQPV causes disease with high mortality in red squirrels, but does not seem to cause disease in greys. Not all populations of introduced greys carry the virus (those in Italy do not, and the virus was reported to have reached (southern) Scotland for the first time in June 2006[52]). Where greys do carry SQPV, they replace reds around twenty times faster than where they do not carry the disease.

In a recent study led by Queen Mary College, University of London, researchers developed strategies for managing the SQPV disease threat to red squirrels in refuge areas, using as a model Kielder Forest (50,000 ha), the largest designated red squirrel refuge in England[53]. Using mathematical modelling, they identified four routes by which grey squirrels might reach Kielder, initially within two years and in large numbers within 10 years. These were principally along narrow river valleys with wooded hedgerows and small woodland patches. Assuming that greys will not penetrate deeply, or settle within, Kielder because of the unfavourable spruce habitat (they prefer Scots and Corsican pine), the researchers predicted that SQPV disease would burn out at the edges of the forest, although many reds would die in the process. The speed of disease progression would effectively limit the force of infection, with reds dying before coming into contact with the wider population. The likely impact of SQPV on red squirrel populations in Kielder will therefore depend on the size and frequency of grey squirrel incursions into Kielder, and the conservation of reds will depend on minimising contact between red and grey squirrel populations. The study concluded that grey squirrels should be monitored in corridors within buffer zones around refuge areas, and removed when detected.

Health screening is helping to inform management of disease risks in water vole reintroductions.

MTUK update, September 2006

IN 2006 OVER £130,000 IS BEING DISTRIBUTED in nine grants supporting research into species including otters, bats, polecats and American mink, harvest mice, water voles and hedgehogs. Five recent graduates have been awarded internships to the total value of £17,200.

MTUK continues its close interest in monitoring and surveillance of mammals in order to use the resulting long-term data to keep abreast of the status of current populations and to inform decisions as to where best to concentrate our efforts. As well as supporting monitoring schemes run by some other conservation organisations, MTUK continues to run its own two general mammal surveys.

78% of participants in the *Living with Mammals* survey in 2005 found their sites to be home to mammals that have been defined as Species of Conservation Concern (SoCC), thereby highlighting the importance of the urban environment in conservation. Over the space of just a year, there appears to have been a striking fall in the numbers of hedgehogs observed in eastern and north west regions of the UK. Counts of hedgehogs along roads in England decreased by 7.5% each year for the first four years of the *Mammals on Roads* survey too, and showed a similar decline in Wales. If the trend continues, this will be equivalent to a high Red Alert decline meaning a loss of half the population in 25 years.

In response, MTUK has teamed up with the British Hedgehog Preservation Society to launch a new survey, *HogWatch*, to establish a distribution map of hedgehogs across the UK. Over 16,000 records were received from members of the public in the first three months. The survey continues and is part of a much larger research project coordinated by Royal Holloway, University of London, looking into the causes of such a widespread decline.

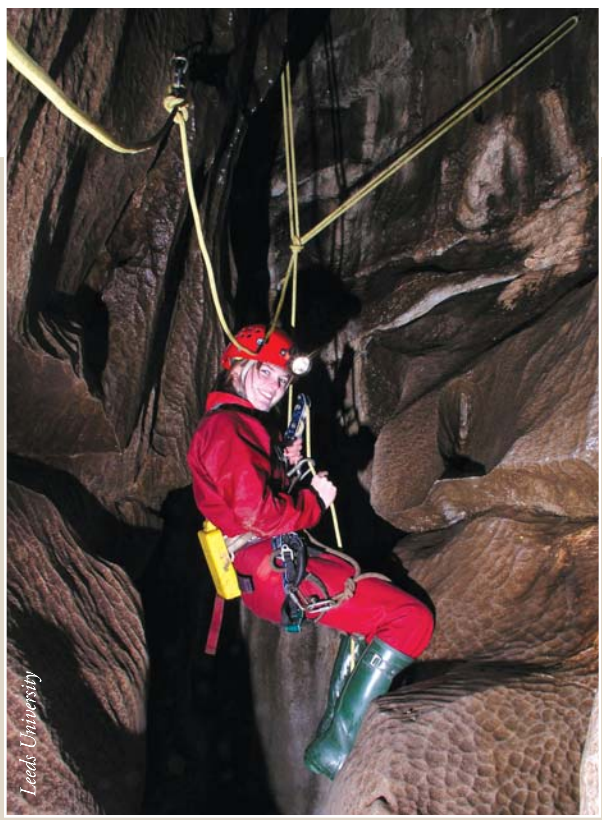
The proceedings of MTUK's conference on wild mammals and disease, co-organised with WildCRU, which addressed squirrel poxvirus, badgers and bovine TB and seals and distemper, is now published in a special edition of the journal *Biological Conservation*.

MTUK Projects Funded during 2006

- Dr Dan Forman and Dr Carlos Garcia de Leaniz, University of Wales Swansea, are examining the seasonal activity patterns of otters and how they relate to field sign occurrence.
- Dr David Hill, University of Sussex, is establishing the distribution of Bechstein's bat in southern England.
- WildCRU has received further funding to look into the relationship between polecats and American mink and to investigate the metapopulation dynamics and habitat use of harvest mice.
- Professor Paul Racey, University of Aberdeen, is looking into whether radar can deter bats from approaching and colliding with wind turbines.
- Practical work to conserve water voles in north east Scotland carried out by Professor Xavier Lambin, University of Aberdeen, has received further funding and Dr Paul Bright, Royal Holloway, University of London, continues habitat restoration around key sites for water voles in England and Wales and eventually Scotland.
- MTUK is supporting the Bat Conservation Trust investigation to see if general mammal counting can be combined with bat monitoring.
- Dr Paul Bright has also received funding to identify practical strategies to reverse the hedgehog decline and MTUK contributed towards the cost of a seminar about hedgehogs held in April by the British Hedgehog Preservation Society.

MTUK Student Projects

- *Natalie Boyle (pictured right), University of Leeds, is investigating the effects of cave gate replacement on bat activity at swarming and hibernation sites.*
- *John Herbert, Royal Holloway, University of London is using Mammals on Roads data to estimate annual numbers of road casualties and their impact on mammal populations.*
- *Trianna Angele is working with freelance ecologist Ian Davidson-Watts on identifying breeding roost sites of rare woodland bats on the Isle of Wight, including Bechstein's and barbastelle.*
- *Stacey Hewitt at WildCRU is looking at whether social groups of European badgers exhibit dominance hierarchies.*
- *Karen Kennedy, University of Aberdeen, is examining the ecology and behaviour of Daubenton's bat in relation to the epidemiology of European bat lyssavirus 2 (EBLV-2).*



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Mammals Trust UK

Mammals Trust UK is dedicated to working in partnership with voluntary organisations, wildlife experts, government and industry to conserve wild mammals and their habitats throughout the British Isles.

Our Aims

- To raise funds for research and practical conservation based on sound scientific understanding.
- To increase public awareness, bring together all 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 is the fifth 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 Mammals Trust UK at the address and phone number above.

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