



30th EUROPEAN MUSTELID COLLOQUIUM

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Pine marten (*Martes martes*) near Kilmeadan, Co. Waterford Ireland.

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Weasel (*Mustela nivalis*) in Białowieża Forest in Poland.

The good, the bad and the ugly: an introduction to Irish mustelids

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As with most groups of animals and plants, Ireland's quota of mustelids is limited compared to our neighbours in mainland Europe. The otter (*Lutra lutra*), pine marten (*Martes martes*), stoat (*Mustela erminea hibernica*) and badger (*Meles meles*) have been present in Ireland for several hundred years, if not longer. The North American mink (*Neovison vison*) is a recent invader. Together these five species make up the Irish mustelid community. Research efforts over the last 30 years have varied considerably between these species in Ireland. Much of the early attention focused on the otter because of its perceived conservation importance internationally. The badger has been intensively studied in the last 20 years because of its perceived role as a reservoir for TB in cattle. Most recently, the resurgence of the pine marten, has allowed this species to be targeted. Although it probably remains the rarest mustelid in Ireland its ongoing spread is already leading to conflicts with home owners and game-bird breeders in some areas. The stoat, one of the very few endemic Irish species, remains largely ignored. Drawing on the latest published research as well as ongoing projects, the current status of Ireland's mustelids will be reviewed. Gaps in our understanding of the autoecology of these species will be highlighted and priorities for future funding will be discussed.



Pine marten (*Martes martes*) in the Cooley Mountains, Co. Louth, Ireland.

GPS tracking of mustelids

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Tracking animals by means of GPS receivers has become very popular. In comparison to the conventional VHF radio tracking it is a more economical and accurate way of monitoring wild animals. Although the GPS tags are 5–10 times more expensive than the VHF devices, no additional resources are needed to track the animals, as is the case with the VHF systems. GPS tags have successfully been used with many different species, but until recently it was only possible to track larger mammal species. The miniaturization and development of new software have made it possible to develop GPS tracking systems for medium sized mammals. In 2008, we aimed to develop a small GPS GSM tracker for otters (*Lutra lutra*). As otters do not have a distinctive neck to fit a normal collar, an alternative method had to be developed. We adapted a 1980's radio tracking harness and made it lighter and more flexible. The design was successfully tested on a captive otter in Portugal and was later tested with wild otters. The GPS locations were sent via mobile internet. The GPS GSM trackers were later successfully used with coastal otters in Roaringwater bay, Ireland. The results showed that coastal otters in Ireland are both diurnal and nocturnal as opposed to coastal otters in Shetland, which are mainly diurnal. The results from this study were used for the conservation of otters in the area. Our latest GPS GSM tracker measure only 22 x 22 mm and can be used for 6 - 12 months. This type of GPS tracker can be used on smaller mustelids, like the pine marten (*Martes martes*) and polecat (*Mustela putorius*), and may be possible to develop such devices for smaller mustelids such as stoats (*Mustela erminea*) in the near future. Guidelines for study design and animal welfare issues will also be discussed.



Otter (*Lutra lutra*) in Clonmel, Co. Tipperary, Ireland.

Forty years of otter surveying: what have we learned?

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The fact that there had been a decline of the otter in Britain was first realised in the 1960s and by the early 1970s, the need to monitor populations in some way had been recognised. A method which had first been devised for voluntary surveys was adapted for a series of national surveys carried out separately in England, Wales and Scotland in 1977-79. Ireland was first surveyed in 1980-81. It was subsequently adopted as the 'Standard Method' by the IUCN Otter Specialist Group and has been widely used in Europe, as well as elsewhere. The ambition that it should be repeated every seven years has not been realised but five surveys have been carried out in England and Wales up to 2010 and a fifth is underway in Scotland. Four surveys have been carried out in Ireland. I will review the history and use of the Standard Method in the UK and Ireland as well as some variants, outline some of the problems that have arisen in its use and show how it has informed our understanding of the recovery of the otter population as well as illuminated some aspects of otter ecology.



An otter (*Lutra lutra*) family in Dungarvan Co. Waterford, Ireland.

ORAL PRESENTATIONS



Pine marten (*Martes martes*) in the Cooley Mountains, Co. Louth, Ireland.

Individual variation in dispersal associated with phenotype influences fine-scale genetic structure in weasels

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In general, landscape genetic studies have ignored the potential role that the phenotype of individuals plays in determining fine-scale genetic structure in species. This potential oversimplification ignores an important component that dispersal is both condition- and phenotype-dependent. In order to investigate the relationship between potential dispersal, habitat selection and phenotype, we examined the spatial ecology, body mass and fine-scale genetic structure of weasels (*Mustela nivalis*) in Białowieża Forest in Poland. Our study population is characterized by an almost three-fold phenotypic variation in adult body mass and weasels were segregated in certain habitats according to size. We detected significant genetic structuring associated with habitat within the studied area and analyses of radio-tracking and re-capture data showed that the maximum extent of movement was achieved by weasels of medium body size, whereas the smallest and largest individuals exhibited higher site fidelity. With the unrestricted movement of the medium-sized individuals across optimal habitat, genetic admixture does occur. However, the presence of a barrier leads to unidirectional gene flow, with larger individuals outcompeting smaller individuals and therefore maintaining the genetic break in the study area. This highlights the importance of considering both intrinsic (phenotype) and extrinsic (environmental) factors in understanding dispersal patterns and ultimately, gene flow in complex landscapes.



Weasel (*Mustela nivalis*) in Białowieża Forest in Poland.

Estimating badger (*Meles meles*) population size using mark-recapture and sett activity approaches

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Estimating the size of wildlife populations using capture data is difficult. Much research has gone into developing statistical approaches that are robust and unbiased. However, medium-sized mammalian species are often very difficult to capture due to secretive behaviours, neophobic tendencies, or nocturnal life habits for example. This results in low trapping success for many mustelid species. Low trappability (percentage of the population present that was captured during a session) may cause certain estimators of population size to be biased. We estimated badger (*Meles meles*) population size for a study area (755km²) in Co. Kilkenny using a closed-subpopulation model (CSpM), the minimum number alive (MNA) estimator and a simple multiplicative model (MM) using mean group sizes and active main setts. The estimates from the CSpM and the MM were broadly consistent, with estimated population sizes varying between 553 and 802 amongst capture sessions of the entire area, equating to densities of 0.7-1.1 badger km⁻². These estimated densities were similar to previous reports from an adjacent area in Co. Kilkenny (1.1 badger km⁻²). MNA estimates were on average 49-51% smaller than estimates from the CSpM and the MM. The MNA estimates were severely negatively biased in the present study due to medium-low badger trappability during the study. These results suggest that MNA should not be used as an absolute estimator of population size if trappability is low. However, the estimator may be useful in monitoring population change over time. MNA should not be used to derive estimates of trappability, as negatively biased population estimation will result in positively biased trappability estimation. We recommend the use of multiple approaches to estimate population sizes when and where possible.

Non-invasive genetic monitoring of otter (*Lutra lutra*) populations

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Monitoring and conserving biodiversity is increasingly being recognized as critical for sustainable development. Developing strategies to maintain biodiversity requires baseline information on the current status of each individual species. The non-invasive approach to monitor mammals, especially elusive species, is an increasingly applied technique in obtaining information on the structure, size, genetic diversity and relatedness of a population. This study presents a suite of DNA-based assays to monitor otter (*Lutra lutra*) populations using a non-invasive DNA source (spraints). Novel species-specific real-time polymerase chain reaction (qPCR) assays using fluorescently-labelled TaqMan[®] MGB probes were developed to enable species and sex identification from spraints. Haplotypes were determined by DNA sequence analysis of a section of the mitochondrial DNA control region. Previously published microsatellite markers, some of which were redesigned, were also used for genotype analysis to identify individual otters. The assays are currently being used by the Mammals In a Sustainable Environment project to monitor otter populations in Ireland and Wales. The assays have been shown to work efficiently with tissue, hair and spraint DNA.



Otter (*Lutra lutra*) in the River Barrow, Co. Wexford.

Testimonies on the pine marten (*Martes martes*) and the stone marten (*Martes foina*) hunting in the area of the present natural reserve Montage Della Duchessa (Italy)

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Historical data indicate a general decrease of pine marten (*Martes martes*) and stone marten (*Martes foina*) throughout Italy. Negative effects from direct human persecution (not previously evaluated), anthropogenic disturbance and the distribution of suitable natural environments, like rich coniferous and broad-leaved woods with poor undergrowth, are the main factors limiting the presence of these species. In the study area, hunting aimed specifically at skin trade has been noticed. Reliable information and evidence (including photographs) of this practice have been found, demonstrating its existence until the mid-1960s. Testimonies highlight that between 1940 and 1950 pine marten or stone marten skins cost up to £5. The meat of skinned animals was consumed by the families of hunters. A live specimen was valued to cost up to £15. Snowy grounds gave the best conditions for captures, favouring the identification of tracks and holes where traps were triggered. Traps were the instruments most widely used because they allowed capture of the animal without ruining the skins. Burning dry and damp grass inside the animal's hole produced abundant smoke, driving the animals into the traps. Hunting can be included among the factors affecting the current distribution of the species in this area.



Stone marten (*Martes foina*) from southern Portugal. This marten was released after a trapping session conducted by the University of Lisbon.

Population status of pine marten in Mourne Mountains of Northern Ireland

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Pine marten are a species of high conservation priority in Northern Ireland, yet the species' general ecology, distribution and population status are poorly understood. To address knowledge gaps in terms of the conservation management of the species, a research project was undertaken that aimed to investigate the population abundance and status of pine marten in the Mourne Mountain region of Northern Ireland. The study involved the use of non-invasive survey techniques to produce population abundance estimates. It was the first study of pine marten populations at a regional level in Northern Ireland. In total, 126 hair tubes were deployed in forest habitat throughout the Mourne Mountains, for a period of approximately 6 months (June–November 2011). Hair samples were analysed using DNA techniques to produce individual identity data for pine marten, which was then used to estimate abundance using various statistical methods. Abundance estimates for the adult breeding population of pine marten in the Mourne Mountains were 23 individuals (95% CI 18–31). Mean density estimates of 0.53 pine marten per km² of forest habitat were obtained. This study indicates that there is a critical requirement to develop a conservation management strategy for pine marten in the Mourne Mountains.

Can SNP-profiling be used for identification of ranch and feral mink (*Neovison vison* Schreb., 1777)? The growth hormone gene example

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Single nucleotide polymorphisms (SNPs) represent the most common type of genetic polymorphism in the genome and are often considered to be an alternative to population differentiation with microsatellite markers. In the present study the nucleotide sequence variation of the American mink (*Neovison vison* Schreb., 1777) growth hormone gene was analysed in terms of differences between populations. For this purpose 1,520-bp region of the mink genomic DNA was amplified by nested-PCR and sequenced. The study included 389 individuals of wild mink (Canada), ranch mink (six colour types, Poland) and feral mink (Poland, Iceland). Sequencing allowed to determine the nucleotide composition of previously unrecognized non-coding regions and to identify 12 new SNP substitutions, one single nucleotide deletion and one ins/del polymorphism. 45 haplotypes and 86 genotypes, according to described polymorphisms, were observed. The results revealed a significant differences between originally wild mink and domesticated animals (both ranch and feral). The results of the present study, supported by further analysis, can help in effective genetic monitoring of feral mink, as some differences were also found between ranch and feral mink. On the other hand, similarity of genetic indicators of feral mink indicates their similarity to farm animals and prove their close genetic relation.

Genetic structure of Eurasian badgers (*Meles meles*) and the colonization history of Ireland

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The present study examined the contemporary genetic composition of the Eurasian badger, (*Meles meles*), in Ireland, Britain and Western Europe, using six nuclear microsatellite loci and a 215-bp fragment of the mitochondrial DNA control region. Significant population structure was evident within Europe (global multilocus microsatellite. $F_{ST} = 0.205$, $P < 0.001$; global mitochondrial control region $\Phi_{ST} = 0.399$, $P < 0.001$). Microsatellite-based cluster analyses detected one population in Ireland, whereas badgers from Britain could be subdivided into several populations. Excluding the island populations of Ireland and Britain, badgers from Western Europe showed further structuring, with evidence of discrete Scandinavian, Central European, and Spanish populations. Mitochondrial DNA cluster analysis grouped the Irish population with Scandinavia and Spain, whereas the majority of British haplotypes grouped with those from Central Europe. The findings of the present study suggest that British and Irish badger populations colonized from different refugial areas, or that there were different waves of colonization from the source population. There are indications for the presence of an Atlantic fringe element, which has been seen in other Irish species. We discuss the results in light of the controversy about natural versus human-mediated introductions.



A garden badger (*Meles meles*) near New Ross, Co. Wexford, Ireland.

How weather affects badger bodyweights and activity in Ireland

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Working with detailed datasets of badger weights (Four Areas Project) and badger movements (BadgerTrack) it has been possible to investigate annual trends in activity and weight. These trends show opposite shapes across the year; badgers are lightest, but most active, in the summer months and heaviest, but least active, in the winter months. It is also possible to discern inter-annual differences in these trends. Using a series of generalised linear models and generalised linear mixed models it has been possible to determine the importance of temperature and rainfall fluctuation on the bodyweight and activity of Irish badgers. Badgers are lighter when the weather is relatively cold, whatever the time of year. Badgers are also lighter when rainfall is relatively high, but only while they are gaining weight (late summer to early winter). Similarly, badgers are less active when the weather is relatively cold, whatever the time of year, but there are no simple relationships between rainfall and badger activity. The inter-annual variation in the behaviour of badgers demonstrates that they are constantly responding to the world around them. While photoperiod has been suggested as a cue for both autumn bodyweight increase and winter inactivity in badgers, it is clear that other climatic cues are affecting behaviour.

The current distribution and potential for future range expansion of feral ferret (*Mustela putorius furo*) in Ireland

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Predicting the potential invaded range of a non-native species is an important tool for conservation biology. The ferret (*Mustela putorius furo*) is a known invasive outside its native range and has recently been confirmed as a feral species in Ireland. To determine the current distribution of feral populations, an all-island survey was conducted during 2006 - 2008. Using the results of this survey, a landscape modelling approach, using presence-only data was applied to predict the potential future range of this species in Ireland, given the availability of suitable habitat. The results suggest that Ireland appears to be potentially highly suitable for ferrets and therefore the possible ecological impacts of this species in Ireland are discussed.

The genetic legacy of the 19th century decline of the British polecat: evidence for extensive introgression from feral ferrets

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In the 19th century the British polecat suffered a demographic contraction, as a consequence of direct persecution, reaching its lowest in the years that preceded the First World War. The species is now recovering and expanding eastwards from their 19th century refugia, but introgressive hybridization with feral ferrets has been reported, which could be masking the true range of the polecat in Britain and introducing domestic genes into the species. We used a fragment of the mitochondrial DNA control region and 11 microsatellite loci to characterize the frequency and extent of hybridization and introgression between the two species and assess if the 19th century decline corresponded to a genetic bottleneck in the polecat. The proportion of admixture detected in the wild was extremely high (31%) and hybrids were more frequently found outside Wales, suggesting that hybridization is more likely to occur in the eastern edge of the polecat expansion. The patterns observed in the mitochondrial and nuclear DNA data show that introgression was mediated by crosses between male polecats and female ferrets, whose offspring backcrossed with polecats. No first-generation (F1) hybrids were identified and the broad range of observed *q*-values agrees with a scenario of past extensive hybridization between the two species. We did not find consistent evidence for a genetic bottleneck in the British polecat, which could be interpreted as a consequence of contemporary and subsequent hybridization with ferrets. Our results highlight the importance of the Welsh polecat population for the conservation and maintenance of the genetic identity of the British polecat.



A captive polecat/ferret hybrid in a natural setting in Macroom, Co. Cork, Ireland.

Down into the darkness- martens exploiting an unusual winter food resource

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It is well known that predators exploit locally seasonally abundant food resources. In this study we report on an extreme example of this behaviour in martens occurring in an extensive system of deep underground tunnels used as a hibernation site for bats. The underground system, built in the 1930s, consists of over 30 kilometres of tunnels up to 50 metres below ground level. Following the abandonment of the system by people, bats adopted the tunnels as a hibernaculum and in past decades the winter bat population has increased to nearly 40,000 animals. Along with this increase in bats there has been increased evidence of martens in the system. Faecal analysis of scats from the tunnels has shown the martens to be feeding on a variety of bat species. However, it was unclear which species of marten were using the system, and whether the bats were being actively hunted or martens were simply scavenging moribund individuals that had fallen to the floor. Molecular techniques and field surveys have been used to answer these questions. Evidence is presented that both stone and pine marten are actively hunting bats in the tunnels many hundreds of metres from the entrances and in total darkness.

Ranging behaviour in Irish badgers

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The understanding of territory use and ranging behaviour in badgers is largely based on marking of territory borders, and radio-telemetry of individuals over a relatively short periods. Using satellite tracking over the course of two years, the positions of badgers were recorded multiple times each night that they were active. This provided a more detailed picture of the ranging behaviour of these animals. The home range used by Irish badgers, at least in this agricultural habitat, varied enormously through the year, with tiny ranges recorded in winter, and much larger ranges in summer. Males had larger home ranges than females and made more excursions outside their range than found in other studies. Interestingly, individuals of the same social group shared large parts of their home ranges, but also used considerable areas which the other members of their group did not use. Thus the classic idea of "territory" as an area defended by all group members, and within which they largely remain, did not fit the data obtained. The results will be discussed in relation to the meaning of "territory" and "home range" in an animal which behaves so differently between seasons and individuals in a social group.

How different are British and Irish badgers

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Genetic studies show Irish badgers to be more closely related to those in Spain and Norway than to those in the UK. Genetic information from published sources illustrates clearly that there are two distinct populations of badgers in Europe, with Irish badgers in one clade and UK badgers in the other. We will discuss the implications of these genetic differences, in the light of other types of evidence. These include differences in the diet of the two sub-populations, with Irish badgers consuming a much wider and more seasonal diet, than UK badgers, which rely on earthworms to a very large extent at all times of the year. Irish badgers are smaller, and show less sexual dimorphism in bodyweight than those in the UK. Breeding behaviour also seems to be timed rather differently, with Irish badgers breeding rather later than those in the UK. In addition the territorial behaviour of Irish badgers seems to be much less clear-cut, with these badgers ranging much more often into neighbours' territories than expected from observations of similar populations in the UK. These differences will be illustrated with supporting data and their possible significance for separating the populations taxonomically will be discussed.



A family of badgers (*Meles meles*) near New Ross, Co. Wexford, Ireland.

Distribution, density and diet of the European pine marten (*Martes martes*) in the midlands and east of Ireland, as determined by the molecular analysis of non-invasively collected samples

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The European pine marten (*Martes martes*) population in Ireland has increased in recent decades as a result of reduced persecution and increased habitat availability. A population study, using non invasive techniques, was undertaken in the midlands of Ireland, where the population is thought to be thriving, and in the east of Ireland where the pine marten is less common. Sightings surveys, hairtube surveys and scat surveys were used to determine the distribution and relative abundance of both populations. Molecular techniques were utilised to determine the origin and prey content of scats, and the species, sex and genotype of hair samples collected. Results of the population studies confirm the pine marten population in the midlands of Ireland to be at high density compared to that of the population in the east. The possible effect of pine marten density on the distribution of both the native red (*Sciurus vulgaris*) and invasive grey squirrel (*Sciurus carolinensis*) distribution will also be discussed.

The use of GPS and GSM technology to track badgers

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Satellite tracking technology is now being used to follow badgers living in the wild. The advantages and weaknesses of this technology will be discussed, as well as an introduction to their use, including programming prior to deployment, the use of a range of schedules for taking GPS readings, and advice on the content of the text messages sent by GSM. Animal welfare considerations of using the collars in badgers will also be discussed. The scientific benefits of this approach will be explored, including how individual badger movements can be tracked over lengthy periods of time, allowing the areas used by the badger to be defined with enough resolution to determine monthly changes across the seasons. Incursions into neighbouring territories can be monitored, and longer distance movements, as finding the badgers after such movements is not a problem. Because of the daily or every second day download of text messages, immediate notice of changes in behaviour or even mortality signals can be detected, allowing remote monitoring of the badgers. Although positional information is received without needing to recover the collars, when they are recovered, other pieces of information are available in the collar's memory, such as the ambient temperature.

Behaviour of captive-reared orphaned stone martens (*Martes foina*) after re-release

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It is common practice to re-release wildlife into the wild. This is done for a number of reasons, even though there are few reliable data on the effectiveness of this practice either from an animal welfare or from a cost effectiveness point of view. This study looks at the post-release behaviour and survival of captive-reared orphaned stone martens, using radio-telemetry to collect data. Objectives of this study were (1) to determine the post-release survival of martens, (2) to examine the pattern of their post-release ranging behaviour, and (3) to determine the extent to which they come into conflict with humans. Mortality rates did not exceed rates expected during natural dispersal. Young martens were able to establish sustainable home ranges. A difference was found between male and females ranging behaviour and finally, there was no human-wildlife conflict.

Does tunnel type and size matter to stoats (*Mustela erminea*) and weasels (*M. nivalis*)?

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At present there is no quantified method or technique for assessing the abundance and occupancy of stoats and weasels in the UK. Without a viable method to efficiently assess occupancy and abundance important decisions for effective management and conservation cannot be taken. In this study we are evaluating different methods of determining species occupancy, including tracking tunnels. This presentation will report on a field trial comparing the ability of two types of baited tunnels with differing aperture size to attract stoats (*Mustela erminea*) and weasels (*Mustela nivalis*). The study was undertaken at two independent sites in Hampshire and Sussex. At each site a total 40 tracking tunnels were baited with chicken meat for 10 days at a time, totalling 400 trapping nights. The two variants of tracking tunnels were tested in combination with aperture sizes of 70mm, 65mm, 60mm and 55mm. Results of this trial will be discussed in relation to the effective use of tunnel type and aperture size to the detection of both species.

A two tier badger social system in Ireland- the haves' and the have not's

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There has been a traditional division of animal populations in to those that breed, and those that, for one reason or another, do not breed. This is likely to be especially pronounced in badgers (*Meles meles*) for whom breeding is expensive. Here populations of badgers on two off shore islands, that show evidence of this trend, are described. The first population is on Coney Island, off the North West coast of County Sligo. The badgers colonized the island in the last century and first dug setts in a fertile area in the centre of the island. The two social groups at the centre of the island are the only groups with stable large main setts, territories and that produce live cubs. The other social groups have unstable main setts, and small territories, in sub-optimal habitats, such as sand dune and among houses. The second population is on Great Island in Cork Harbour. Most territories (9) are over 50 ha and breeding occurred at these setts, however six territories are less than 50 ha and breeding (as defined by production of live cubs) has not been recorded in any of these territories. Clearly, territories are much smaller on the islands than on the mainland, but a similar pattern of breeding and non-breeding may occur. The implication of this pattern will be discussed.

Foraging Eurasian badgers (*Meles meles*) and the presence of cattle in pastures. Do badgers avoid cattle?

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The proximity of badgers to cattle, and their propensity to utilise pastures containing cattle, is of fundamental importance in understanding transmission possibilities for *Mycobacterium bovis* between a wildlife reservoir and cattle on farms. A study of free-ranging badgers carrying Global Positioning System (GPS) collars allowing their movements to be tracked provided data on their use of a series of paddocks with and without cattle present. The data on badger movements were plotted against the grazing records on a farm, allowing comparison of the badger usage of each paddock when it had and when it had not cattle present. Badgers were found to avoid foraging in the paddocks containing cattle. They also showed varying levels of preference for different paddocks, but even preferred paddocks were usually avoided when cattle were present. This study thus demonstrates convincingly for the first time that free ranging badgers avoid entering paddocks containing cattle so direct contact is unlikely to be a major route of *Mycobacterium bovis* transmission between these species. It therefore suggests that alternative strategies for controlling cross-infection between badgers and cattle might focus on other likely routes of transmission such as the abnormal behaviour of unhealthy badgers, contaminated fomites or contact between badgers and cattle in farmyards or housing.

Pine marten and stone marten personality: spatial behavior and home range in a fragmented rural landscape

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Little is known about the spatial behaviour of the pine marten and stone marten and their variability over time. Here we present a method that allowed us to identify four types of spatial behaviours. Thirty-four (20♂/14♀) pine martens and thirty-one (18♂/13♀) stone martens were radio-tracked over a six-year period in France (Bresse), in a highly fragmented habitat. Two philopatric patterns were identified with “*stationary*” individuals who reside in one limited area throughout their monitoring and “*explorer*” individuals who reside in the same area but who perform temporary explorations outside. Our approach also allows us to identify two dispersal behaviours: “*shifter*” individuals have their home range which gradually shift over time and “*one-way*” individuals who suddenly change their home range by performing a large unidirectional movement and settle up farther. We investigate both internal (age, sex) and external (time, season) factors determining those spatial patterns. From philopatric individuals only, we then estimated seasonal and annual home-ranges with traditional MCP and kernels methods and with the α -LoCoh new method. We also looked for intra- and inter-species overlap.

Long term monitoring of a pine marten population in Portlaw Woods using DNA analysis of scat and hair samples

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Portlaw wood is a 320ha site and is part of a commercial conifer/mixed forest in Co. Waterford, Ireland. Scat and hair samples have been collected on a regular basis since 2006 in order to develop the use of genetic tests. Samples have been analysed for species and sex using qPCR. Microsatellite analysis has been used to identify individual animals over that period. The qPCR data has been used to screen samples and thereby reduce the failure rate of microsatellite analysis, this was particularly useful for faecal samples as the overall success rate was low. The distribution of scats was patchy and great heterogeneity was found in the use of hair traps. Thus the use of both scats and hair samples was found to be important as neither was 100% effective in detecting marten. The data has provided estimates of home range and territorial fidelity in this group of pine marten.

Temporal distribution, habitat selection and food of the American Mink (*Neovison vison*) in south eastern Ireland

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The aim of this project was to show the distribution of American mink (*Neovison vison*) in south eastern Ireland from 1982 to 2012. Habitat variables and scat contents were also investigated. This follows on from earlier research on this topic where mink distribution records were collected from the national otter surveys and from previous investigations into mink diet from around Europe. The research was carried out by searching river banks and coast for mink scat using a standard survey method. It was found that between 1982 and 2012, overall mink occurrence increased by +19.3% from 1.9% to 21.2% in the area. Mammals, invertebrates and fish were most frequently found in the mink scats notably the pygmy shrew (*Sorex minutus*), lagomorphs, and Myriapods. Mink were associated with broad deep rivers, bedrock and boulder substrate and negatively associated with human disturbance. The distribution results suggest that the mink population in the area is stable and possibly slightly increasing. The results of the scat analysis show that mink have a varied diet similar to European reports. In order to get a better picture of the mink in Ireland, it is recommended that more widespread surveys and scat analysis need to be conducted.



The American mink (*Neovison vison*) on trail cam in Co. Carlow, Ireland © Brian Power

Poster Presentations



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Otter (*Lutra lutra*) in Clonmel, Co. Tipperary, Ireland.

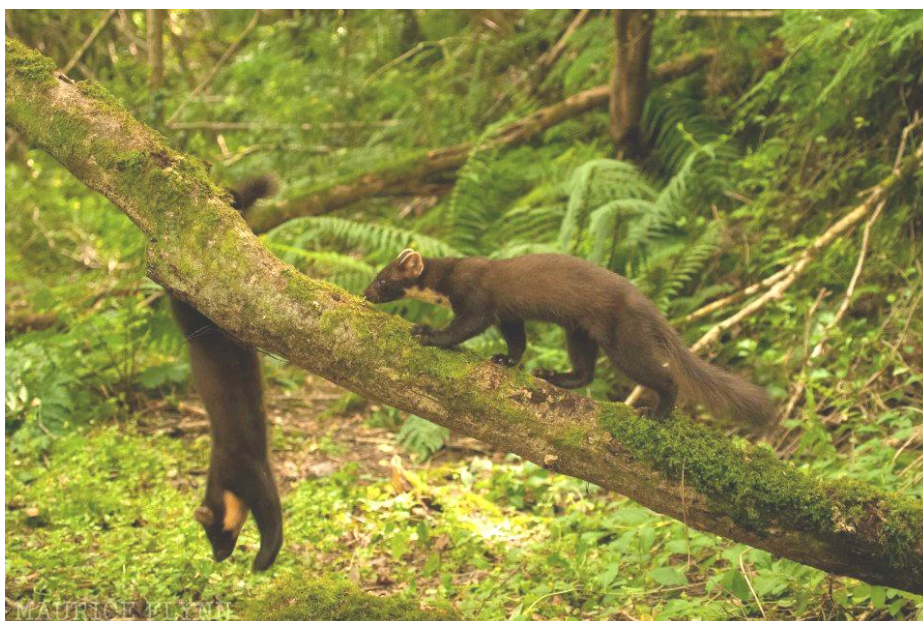
Age determination of the pine marten (*Martes martes*) and the stone marten (*Martes foina*): a non-invasive method

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Age determination is essential for investigations of many aspects of the life history and demography. Conservation and management of wildlife requires knowledge of the age structure of populations to estimate growth rates, life span, age of maturity and crucial life-history parameters. However, determining the age of live animals without using invasive methods is never an easy task. The most reliable and commonly used method for estimating the age in carnivore species is the extraction of a premolar or canine for an analysis of the cementum lines, the age being estimated from the number of growth lines present in the cementum of the tooth. On pine and stone martens, validation requiring a data set of animals with known age is missing. Here we present a method that allowed us to estimate the age of live animals, e.g. captured to be monitoring by radiotelemetry, without tooth removal. We discriminated a large data set on carcasses aged by analyses of teeth cementum annuli (n = 140 pine martens and n = 333 stone marten), on dental condition and morphological measurements (body mass, tail and body lengths, neck circumference). We then used the discriminant function to assign animals of unknown age in three age-classes based on a birth date on April 1st of the year: juvenile (0-6 months), subadult (7-18 months) and adult (older).



Pine marten (*Martes martes*) kits near Kilmeadan, Co. Waterford, Ireland.

Climate and refugial origin influence the mitochondrial lineage distribution of weasels (*Mustela nivalis*) in a phylogeographic suture zone

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Overarching trends can be seen in European mammalian phylogeography, yet it is clear that species responded differently depending on adaptations to past environments. We built upon previous work on the phylogeography of weasels (*Mustela nivalis*) in Europe by utilizing well-preserved museum specimens from a proposed phylogeographic suture zone. The complete cytochrome *b* gene was amplified from 49 individuals from present-day Poland and analyzed with previously published data on a European scale to identify glacial refugia and infer recolonization processes. Bayesian coalescent analysis revealed the importance of the Last Glacial Maximum and the Younger Dryas in the diversification of, and demographic changes in, identified mitochondrial lineages. Our analysis, in conjunction with the available fossil data, strongly points to a Carpathian origin for one of the lineages and further highlights the importance of this region as a refugium for European mammals. Weasels originating from this refugium appear to have a selective advantage over weasels from other lineages in certain environments in the suture zone in central Europe, with climate clearly influencing the distribution of mtDNA lineages. This has important implications not only for our understanding of how past climatic events shaped the genetic architecture of species, but also how they will respond to current and future climatic changes.



Weasel (*Mustela nivalis*) in winter coat, Białowieża Forest, Poland.

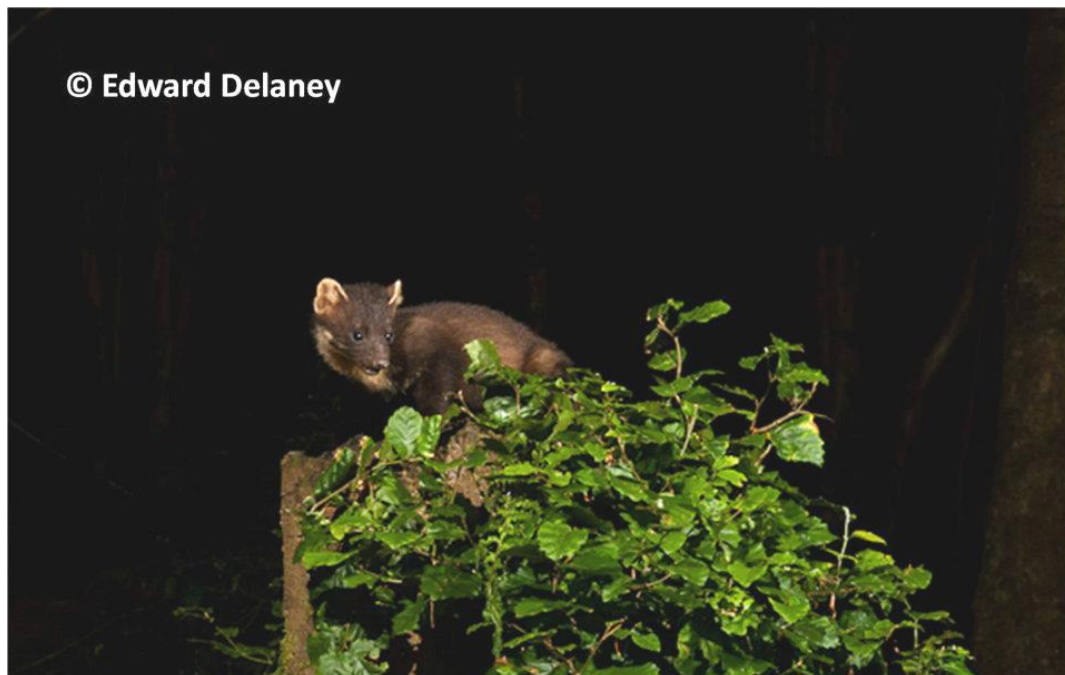
Population structure and bat predation analysis of pine marten (*Martes martes*) and stone marten (*Martes foina*) in the Nietoperek bat hibernation site, Poland

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The Nietoperek bat reserve in Western Poland is based in underground fortifications constructed in the 1930s by Germany to defend the old border with Poland. The tunnels provide a winter hibernation site for between 20,000 - 30,000 bats including several rare or endangered species. The surrounding area consists of fragmented forest and farmland supporting pine marten and stone marten species. This habitat fragmentation restricts the marten's ranges. During recent bat censuses marten scats have been found in the tunnels as well as evidence that marten may have been preying on hibernating bats. Using DNA extracted from non-invasively collected samples, this project aims to determine; the population density and distribution of both marten species, if both marten are involved in predation of bats, if there is any preferential predation of bat species, and if there is any significant impact on the bat population as a result of marten predation. Scat samples will be collected above ground and in the tunnels. Hair tubes will be set above ground where scats are present and underground if adapted to ensure no interference to the bat population. Samples will be analysed using molecular techniques adapted for non-invasive samples including species identification, sex determination and dietary analysis using real time PCR, and individual identification using microsatellite analysis. Spatial analysis of territorial behaviour will be by Arcview GIS.



Pine marten (*Martes martes*) near New Ross, Co. Wexford, Ireland.

Mustelids and road mortality: A monitoring programme in the Central Apennines, Italy

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The data presented here have been derived from the monitoring of wildlife mortality due to road accident in the province of Rieti. For this purpose 10 sample paths were identified within the study area, covering a total of 207 km. The road stretches were chosen to monitor the effects of vehicular traffic intensity, altitude, and the type of crossed natural environment. The selected paths ranged between 200 and 1700 meters above sea level. The surveys were conducted from August 1st 2011 to July 31st 2012 on a weekly basis and involved 10 surveyors. In the study area, five of the six mustelid species present in Italy have been recorded, including the pine marten (*Martes martes*), stone marten (*Martes foina*), weasel (*Mustela nivalis*), polecat (*Mustela putorius*) and badger (*Meles meles*). The Eurasian otter (*Lutra lutra*) is absent. 172 cases of mortality have been observed overall, including amphibians, reptiles, birds and mammals. 26 cases involved mustelids, including 12 badgers, 11 stone marten and three weasels. No road casualties of pine marten and polecat have been observed.



Weasel (*Mustela nivalis*) in Białowieża Forest in Poland.

The population genetics of pine marten (*Martes martes*) in Co. Waterford, Ireland

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Pine marten (*Martes martes*) populations in Ireland have in recent years undergone population expansions following dramatic population declines during the 19th and 20th centuries. To help survey pine marten distribution, non-invasive DNA techniques have been developed and optimised to aid monitoring of elusive species. During June, July and August 2010, hair tube and scat transect surveys were used to non-invasively sample a pine marten population in Tower Hill Wood, Portlaw, County Waterford, Ireland. DNA was extracted from all samples and species and sex tests were performed using real-time PCR. Hair and scat samples were selected for genotyping based on the C_T value obtained from the sex test, a useful indication of the quantity of nuclear DNA in the sample. Twenty-five percent of all scat samples and 50% of all hair samples were successfully genotyped. A total of 6 unique genotypes (individuals) were detected in the Tower Hill site. These genotypes were added to a catalogue of previously detected pine marten from the greater Portlaw area. A total catalogue of 42 genotypes was used for statistical analysis. Genetic variation was very low in the population ($H_E = 0.48$). Power analysis indicated that it was not possible to determine relatedness levels within the population and there was no genetic structuring. More microsatellite markers with increased allelic variation are needed to perform sufficient analysis of pine marten populations in this region.

Irish badgers (*Meles meles*) and biodiversity

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The impact badgers in Ireland have on biodiversity is of interest. Research was carried out at different areas around badger setts. A study area of 10m² was surveyed at the sett and again 20m and 50m away. Plant species and any badger activity were recorded. Soil analysis in the laboratory was carried out to ascertain levels of bacteria. Nine setts were surveyed. High numbers of elder trees (*Sambucus nigra*) of different sizes were found around many of the setts. Bramble was also common as were nettles and other mixed hardwoods. Seeds were present in one of the latrines. Soil analysis showed that soil from one sett entrance had a much higher number of bacteria than other soil samples 20m and 50m away. The high proportion of elder trees near setts is probably due to badgers. Badgers are known to eat elderberries. Seeds can pass through their digestive system and still germinate in latrines. Blackberry seeds (*Rubus fruticosus*) are known to be aided in germination by a badger's digestive system. The discarding of old bedding may contribute to nutrient dispersal. In addition, the carrying of new bedding is likely to spread seeds. Scientific literature shows that removal of badgers is likely to cause an increase in numbers of feral cats, hedgehogs and foxes. Badgers setts provide favourable habitat for fungi, especially the stinkhorn fungi (*Phallus impudicus*).

Non invasive trapping for small mustelids - First results of an IR trapping device, the 'Mostela'

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Cameratrapping is used in ecological field studies for a wide range of mammals. However, for small mustelids like the weasel and stoat, it is difficult to get video footage. This has to do with the size and hidden nature of these species in combination with the technical difficulties associated with cameratrapping small and fast animals. Here we present the first results of the 'Mostela', a cameratrap device in which we combine an IR-camera with a footprint tracking tunnel in a box to determine the presence of small mustelids. The first results of this non-invasive method are promising and can contribute to research on weasels, stoats and perhaps other small mammals, not only for their detection but for example the recognition of individual animals.

Visitation networks of badgers (*Meles meles*)

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Badgers are a social mustelid species, typically living in social groups that defend a territory. Research suggests that average social groups in Ireland are made up of 2-6 adult badgers. These close-knit groups maintain regular direct contacts, but interactions between social groups are thought to occur less frequently. We use mark-recapture data to infer badger movements and the location of main setts as the centroid of putative territories derived using Voronoi tessellation methods. Badger movements often extended beyond putative territorial boundaries (>80%) within the study population. When these movements were mapped, large-scale badger sett visitation networks were identified. Badgers are a host species for *Mycobacterium bovis* (TB). If there is an environmental reservoir of TB in setts (e.g. within the soil), or if there are interactions with infectious individuals during these sett visits, these visitation networks could contribute to the spread of *M. bovis* across badger populations. Future work will investigate the hypothesis of transmission networks facilitated through sett visitation when the test status of badgers becomes available.

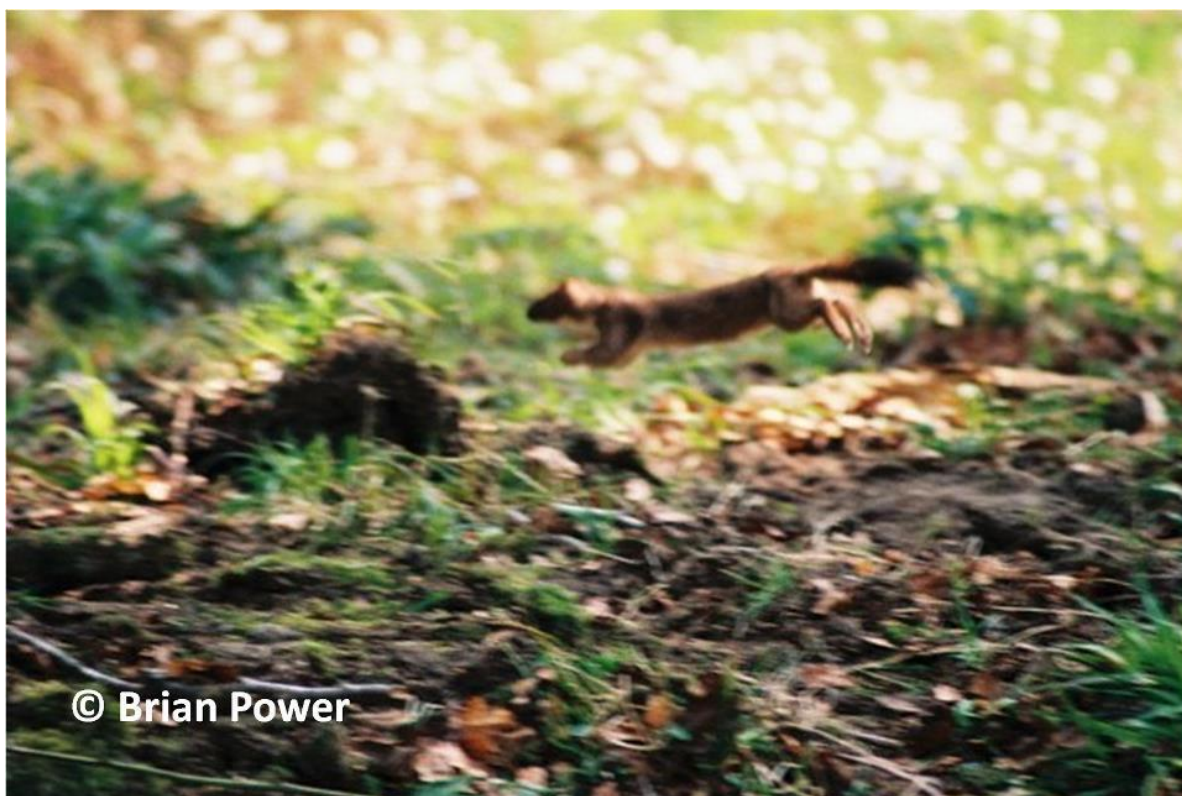
The use of hair tubes to detect presence of stoats and weasels

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Relatively little is known about the population status of stoats and weasels in Britain. These species are difficult to monitor because they do not leave obvious field signs, and they are seen only rarely. At present the only way of monitoring them on a large scale is by using records from gamekeepers of the numbers of animals trapped and shot, collected as part of the National Game Bag Census (NGBC). These data have been used to describe national trends in the abundance and distribution of weasels and stoats since 1961; however it is recognized that there is an urgent need for increased detection, and new techniques are required to survey and monitor these species. In 2010 a pilot project was carried out to investigate the effectiveness of hair tubes deployed by volunteers to detect the presence of Irish stoats (a recognized sub-species) in county Galway. The success of this has generated the current study, being carried out in west Wales as part of the Mammals in a Sustainable Environment (MISE) project. One km² in each 10km² is surveyed with the help of local volunteers, using baited hair tubes. DNA extracted from hair samples is then used for species identification.



A fleeting glimpse of a stoat (*Mustela erminea*) in Co. Carlow, Ireland.

The installation of mammal mitigation measures on national road schemes in Ireland – an evaluation of five motorway projects

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Over the past ten years, Ireland has embarked upon a programme of unprecedented infrastructural development. Many of these infrastructural projects have focused on improving Ireland's national road network. Roads can create permanent barriers to the dispersal of wildlife as a result of road mortalities and chronic disturbances from human activities and traffic. As a result, the National Roads Authority has developed a series of guidelines to mitigate the effects of roads on wildlife during the various stages of road development. In order to evaluate current practices in the planning, design and construction stages of mammal mitigation measures on national road schemes, desktop studies and post-construction field surveys of five recently completed motorway schemes were undertaken. A total of 101 mammal underpasses (600 mm Ø) and 30 mammal ledges were identified across the five schemes. The crossing structures were reviewed with respect to a number of criteria likely to affect the performance of the structures. These included: susceptibility to flooding; adequacy of associated fencing; and, ease of access for the target species. This study offers an opportunity to evaluate the processes of the planning, ecological assessment, design and construction and post-construction stages of mammal mitigation measures on road schemes and to ensure that continued best practice is incorporated into future road projects.



Otter (*Lutra lutra*) in the Cooley Peninsula, Co. Louth, Ireland.

On the French-Portuguese quest of variable, regional and specific microsatellite markers for the Stone marten

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Developing specific and regional molecular markers is crucial for understanding the molecular ecology of a wild species. Mustelid species have received little attention from molecular ecologists and hence the availability of suitable molecular markers is scarce for numerous species. Here we report the difficulty we experienced in developing a panel of specific microsatellite loci for the stone marten (*Martes foina*) in France. We first observed a very low allelic diversity for a large set of samples of stone marten, with non-specific microsatellite loci. We secondly decided to develop specific loci by screening a large microsatellite genomic databank obtained from a pool of stone marten samples with diverse European origins. We retained 30 tetranucleotide microsatellite sequences with the highest number of repeats (mean = 6.4) but did not obtain more than two alleles. This unexpected and very surprising result raised three questions: i) Are the French population of stone marten and/or the species itself almost monomorphic? ii) Did the samples from which we obtained the genomic databank really come from stone marten? iii) Did the DNA amplification work satisfactorily? To help solve these problems, we conducted a French-Portuguese collaborative study, thanks to the 29th European Mustelid Colloquium, by exchanging samples and primers from a previous Portuguese study. This collaboration helped us refute our two first questions and we are now focussing on a likely bias during the genomic databank construction. This study provides important insights into mustelid molecular ecology, and illustrates that the annual European Mustelid Colloquium is an important place to create collaborative projects and research that could be aimed at a pan-European scale.



Stone marten (*Martes foina*) from southern Portugal. This marten was released after a trapping session conducted by the University of Lisbon.

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- Fáilte Ireland, <http://www.failteireland.ie/>
- The National Biodiversity Data Centre, <http://www.biodiversityireland.ie/>

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Spot the stoats (*Mustela erminea*), in the Comeragh Mountains, Co. Waterford, Ireland. © Brian White

