Ring of Gullion Landscape Partnership

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A camera trap study of the pine marten population of the Ring of Gullion, Co. Armagh, Northern Ireland

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RING OF GULLION

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Introduction

In January 2017, the authors were awarded a contract by Newry, Mourne and Down District Council through the Ring of Gullion Landscape Partnership supported through the Heritage Lottery Fund to undertake a survey of the pine marten (*Martes martes*) population resident within the Ring of Gullion (RoG). The aim of the project was to inform the management of the species within the Area of Outstanding Natural Beauty (AONB) and contribute evidence to the Ring of Gullion AONB Management Plan 2017-2022.

What is a pine marten?

The pine marten (*Martes martes)* is a mammal and is one of 4 members of the mustelid family that are native to Ireland. The Irish name for the species, Cat Crainn or tree cat is a good description as it is around the size of a domestic cat and is often seen close to forests or woodlands. It is an omnivore (i.e. carnivore and vegetarian) but in Ireland, the few diet studies undertaken, show it has more vegetarian tastes than its Scottish cousins (see Lynch and McCann, 2007; Caryl *et al.,* 2012). Until the millennium, the pine marten was restricted to the west of Ireland with a few isolated populations elsewhere. It found itself in this situation, like many predators in Britain and Ireland, due to persecution during the 19th and early 20th centuries. However, the distribution of this enigmatic species has increased since 2000 (O'Mahony *et al.,* 2012) and it now appears to be making a comeback in Northern Ireland including south Armagh (Tosh, 2015).

Why are we looking at numbers?

Unfortunately, history is repeating itself as the pine marten is coming into conflict with man once again. Due to the low forest cover in Ireland and the fact over 75% of the forest present is commercial coniferous plantation (Atkinson & Townsend, 2011), traditional denning places (e.g. tree cavities) for pine marten are often scarce in these artificial landscapes which are subject to rotation logging, so the species is increasingly denning in people's roof-spaces.

In order to reduce conflict we need to understand why pine marten are doing these things. Lack of forest cover and suitable habitat is likely the main reason for conflict occurring but numbers of pine marten in an area might also help us understand why. If we discover that conflict arises when pine marten numbers get to a certain level it would allow land managers to implement mitigation that would reduce problems. Mitigation may include putting up pine marten den boxes or working with game and poultry keepers to reduce the risk of pine marten eating their birds. As a result, this study will help us, and land managers, understand how we could live better alongside one of Ireland's most enigmatic mammals without conflict.

Methods

Study Area

The RoG AONB is located within County Armagh in Northern Ireland (NI) (Figure 1). It was designated as an AONB in 1991 due to its unique geological, natural and cultural make-up and covers an area of 15,353 ha (153.53km^2). Almost three-quarters of the AONB is grassland consisting of a mix of improved and rough pasture. Forest cover is low in the area, consisting of an area of approximately 11.92km^2 or 7.7% of the AONB area which is less than the national average of 10%. Heath, predominantly consisting of Heather (*Culuna vulgaris)* and Gorse (*Ulex europaeus)* makes up 11% of the AONB and 6.1km^2 of this contains the AONB's only European designated site. Slieve Gullion Special Area of Conservation is located on the slopes of Slieve Gullion itself and constitutes one of

the largest areas of dry heath in NI, a European protected habitat. The survey was undertaken within a 75km^2 area of the AONB rather than the entire area due to time and logistical constraints.

Camera Trap Methods

Within this area, camera traps or trail-cams were deployed at 50 locations within forest across the chosen study area (Figure 2). Camera traps were only used in forested areas as studies from elsewhere suggest the species is a forest specialist, and typically doesn't venture far from this habitat (Proulx *et al.* 2004; Croose *et al.* 2016). The Forest Service (FS) manages 83 % of the forestry within the sample area so Cameras were restricted to FS managed forests due existing access via the red squirrel groups (see table 1 for type of forest in survey area). Traps were attached to trees at a height of between 20 and 50 cm at a distance of approximately 400m apart. Traps were left at each location for a minimum of 28 days and a maximum of 117. Traps were set to take photos only and no bait was used to attract animals to cameras. Cameras were deployed between February and May 2017.

Table 1. Summary of Forest Cover within the 75km^2 RoG sample area.

Forest Type	Area (ha)
Broadleaf	72.18
Conifer	428.65
Mixed	27.11
Unknown	47.0
Total	574.94

Estimating pine marten density

We calculated animal density using the Random Encounter Model (REM) presented in Rowcliffe *et al.* (2008) which is a gas based model. This method has been used previously to estimate pine marten numbers in Italy (see Balestrieri *et al.,* 2016 and Manzo *et al.,* 2012). This method was chosen as it is non-invasive as it does not require the identification of individuals, therefore reducing stress to study population, and minimising labour costs. We used the information collected from the field in combination with daily movement distances of marten from Zalewski *et al.,* (2004) of 5.4km. Martens at the time of year sampling was conducted are solitary so a group size of 1 was assumed. All analysis was performed using software R 3.3.2 (R Development Core Team, 2008) with the remBoot package (Caravaggi, 2017). To work out the number of pine marten in the entire RoG AONB we then multiplied the area of forestry (11.92km^2) by the density estimate produced by the model. An estimated density range is produced as it is nigh impossible to give an exact density for a species in the wild.

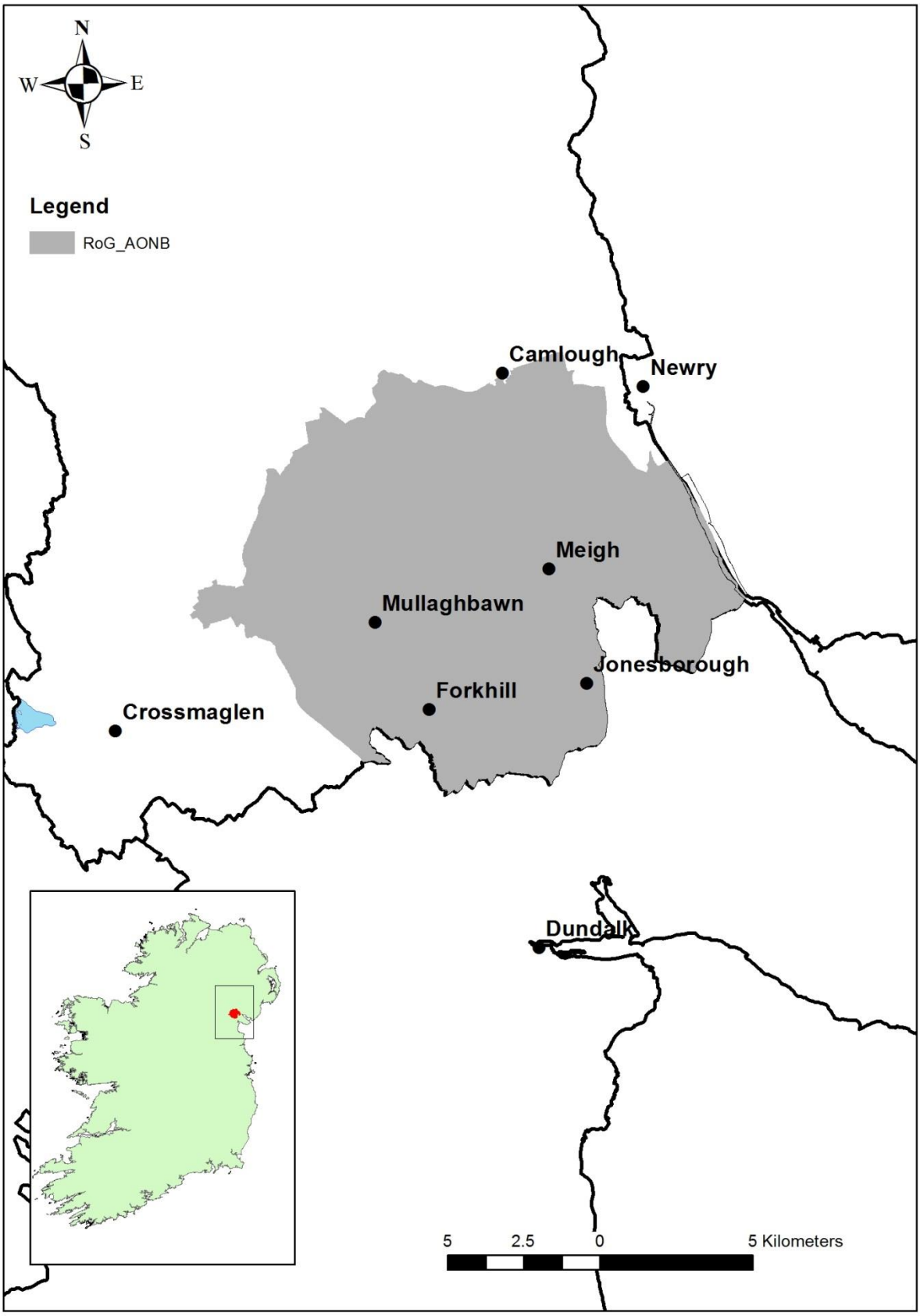

Figure 1.Location of the Ring of Gullion AONB (grey area)

Results

Cameras were set out across RoG for a total of 1473 trap nights (number of cameras X number of nights each camera was out) between February and May. During that time, pine marten were detected at 20 camera traps a total of 57 times (Table 2, Figure 3 & 4). In addition to pine marten, photos of red fox (*Vulpes vulpes*) (Figure 5 & 6), badgers (*Meles meles*), red squirrels (*Sciurus vulgaris*), wood mice (*Apodemus sylvaticus*), sheep (*Ovis aries*), feral goats (*Capra hircus*), red (*Cervus elaphus*) and sika deer (*Cercus nippon*) were collected during the study period (see Table 2 and Appendix 1 for distribution maps). Other species detected included Rabbits (*Oryctolagus cuniculus)*, Irish Hare (*Lepus timidus hibernicus)*, Domestic cat (*Felis catus)*, Mistle thrush (*Turdus viscivorus*), Robin (*Erithacus rubecula*), Blackbird (*Turdus merula*), and Eurasian jay (*Garrulus glandarius*).

Table 2. Summary of detections for a selected number of species during the study at the Ring of Gullion.

Species	at	of points etected	Total number of detections	Number of photos per night
Pine marten (*Martes martes*)		20 (40%)	57	0.038
Red fox (*Vulpes vulpes*)		28 (56%)	68	0.046
Badger *(Meles meles*)		13 (26%)	77	0.052
Red Squirrel (*Sciurus vulgaris*)		12 (24%)	21	0.014
Sheep (*Ovis aries*)		17 34%)	>100	n/a
Goat (*Capra hircus*)		10 (20%)	>100	n/a
Deer (Sika and Red)		11 (22%)	14	0.009

The information collected allowed the estimation of densities of both the pine marten and red fox, therefore the results for both species are presented here. In order to calculate densities for foxes we used 6.4km as the daily movement estimate (derived from Carter *et al.,* 2012) and a group size of 1. Estimates of badgers were not done as the majority of photos were collected at one point and it is likely that a biased estimate badger numbers would result.

Estimated Red fox density in the Ring of Gullion was 0.6 per km^2 (CI 95%, 0.04 – 1.61). Estimated pine marten density in the Ring of Gullion was 0.53 per km^2 (CI 95%, 0.14 – 0.69). Extrapolating these figures to the area of forestry within the RoG AONB (i.e. 11.92km^2) means that there are 6.3 pine martens (CI 95%, 1.66 – 8.22 and 7.1 red foxes (CI 95%, 0.47-19.19).

Conclusion

The pine marten density estimate produced for the RoG AONB is very similar to the estimates produced from the recent All-Ireland Pine Marten Population assessment (see O'Mahoney *et al.*, 2017). In the latter, mean pine marten density was 0.64 km^2 (95%CI, 0.49-0.81) and our estimates fall within the lower confidence intervals of the estimate. Similarly, the estimates from this study fall within the range of estimates produced for the species from Ireland (Sheehy and Lawton, 2014;

O'Mahony *et al.,* 2015:2017) and Europe (see Zalweski and Jedrzejewski, 2006). As a result, pine marten numbers in the RoG AONB are within the range expected for the species in Ireland.

The findings of this work should be built upon by repeating a population estimate for the species within the RoG AONB. This would allow the RoG AONB to be used to monitor the species population growth and act as a proxy for the species generally in NI. This would inform management of the species and prove a useful exercise for the Northern Ireland Environment Agency who have a statutory responsibility to monitor protected species under international legislation e.g. Convention of Biological Diversity and Bern Convention.

As highlighted earlier in the document, another motivation to continue this work should be to use it to inform how conflict arises between humans and pine marten. Continuation of this work, alongside current programs to erect pine marten den boxes and work with people affected by pine marten predation, would continually inform how and when mitigation should be employed to reduce conflict.

Future recommendations

- In order to build on this study and ensure it's usefulness to management of the species in the Ring of Gullion, and beyond, it should be repeated in the future. At present very little information on population trends of this species exist and if continued, this project would fill that void. Information on population trends is a requirement for conservation assessments under international legislation e.g. Habitats Directive, CBD. Therefore, this project has a value that would allow NIEA to help meet statutory requirements. We suggest monitoring of the pine marten population in the Ring of Gullion should be repeated every two years using the same method.
- As numbers of martens are expected to increase, it is likely conflict with people will increase due to the low forest cover and higher predation of gamebirds and poultry. The latter is already recorded in RoG and the former will occur if numbers increase and alternative denning sites are not provided. Therefore, a system to record the occurrence of conflict should be established and protocols to mitigate occurrences should be implemented using available advice. Information should be provided on the Ring of Gullion website and workshops should be run with affected groups. Further advice should also be developed where needed.
- In light of the recommendation above, the pine marten den box scheme should be continued in partnership with the Forest Service. This will reduce the likelihood of pine marten utilising roof spaces and coming into conflict with people. Ensuring the species remains in existing forested areas to den should be a priority. In addition, efforts should be made with private landowners to expand the existing scheme and increase the availability of denning sites outside Forest Service land.
- To increase the value of the information collected thus far, investigations into how pine marten use the Ring of Gullions landscape should be supported. Determining how pine martens move i.e. along field margins will be useful to determine how management actions should be directed, particularly in relation to wildlife conflict. If we find that martens rarely approach a certain type of habitat then this could be useful for siting gamebirds to reduce conflict.

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Appendix 1 - Other related pine marten projects in Ring of Gullion

Boxing Clever - Den boxing

As previously mentioned, it has been suggested that a lack of traditional denning sites i.e. tree cavities is likely a limiting factor on pine marten density. Although it has long been recognised that a scarcity of arboreal cavities for den sites may limit pine marten distribution and abundance in natural habitats, denning ecology of pine marten in Ireland has yet to be appropriately addressed (Brainerd et al. 1995). It has been suggested that anecdotal reports of human-wildlife conflict arising from pine martens denning in roof spaces and attics is in response to lack of above-ground den sites typical in commercial forest plantations, where trees are too young to have developed cavities or dominant species do not produce suitable cavities i.e. Sitka Spruce (*Picea sitchensis,* Birks *et al.* 2005*).* It is considered that alternative below ground sites such as burrows, rocks and tree roots are sub-optimal due to increased level of predation risk from red fox (*Vulpes vulpes)* and certain birds of prey (Brainerd *et al.* 1995) and increase energetic costs that come with a reduction in the facilitation of thermoregulation provided by above ground denning sites (Croose *et al.* 2016).

As such a den dox scheme is being implemented in the RoG. Artificial den boxes are being used to supplement above ground denning sites throughout the commercial plantations of RoG. Boxes are installed 3-4m above ground using ladders and a pulley system. Camera traps are set on an adjacent tree, opposite the entrances to the den box to allow us to non-invasively monitor usage of the boxes. This work not only serves to supplement additional above ground denning sites, and provides an alternative method of monitoring population size in the area by observing den box occupancy over numerous years (Croose *et al.* 2016). But additionally, den boxes provide a novel opportunity to gain insight into the secret life of the rarest mammal in Ireland, with potentials to make new discoveries about the reproductive and denning ecology of pine martens.

Secret life of pine martens – animal-borne sensors

When considering the conservation and management of any species, there is often a need to determine population viability and size. Both factors are largely driven by individual survival, which in turn relies on individual's acquisition and expenditure of energy. As carnivores are thought to function at near maximum power outputs, perturbations to natural environments which may lead to decreased food availability or increased activity can leave populations vulnerable to decline (Scantlebury *et al.* 2014). Homogenous landscape (i.e. commercial plantations) may provide unique obstacles to predators, requiring adaptations to feeding and behavioural ecology.

Although anthropogenic processes are the predominant driver of declines in pine martens, habitat requirements for the species are poorly understood. In addition, intraguild interactions may also have detrimental effects on predator communities (Scantlebury *et al*. 2014), this is particularly true for small carnivores such as pine martens, which are susceptible to competition with, and predation by larger apex predators such as the Red fox (*Vulpes vulpes).* The complex effects of interactions between intra-guild predators may be confounded in degraded habitat such as coniferous plantation where age and structure of forests may limits levels of arborealism and results in energetic trade-offs in hunting strategy, denning ecology and locomotive mode, however the details of such in regards to energetic consequences are currently lacking.

Carnivores species can hunt using a variety of tactics (Hilborn *et al.* 2012; Scantlebury *et al.* 2014), and although the immediate energetic implications of hunting strategies are profoundly different (Wilson *et al.* 2013), the lasting expenditure such as energy allocated to locate resources, or avoid predators in different environments are largely overlooked (Scantlebury *et al* 2014). Any of these energetic costs can be integral in deciding the viability of different behavioural strategies especially

as it links directly with habitat factors such as resource abundance, accessibility and refuge (Carbone *et al.* 1999).

Using modern developments in technologies we will deploy tri-axial accelerometers equipped with an assemblage of sensors, sampling at infra- second rates, we will be able to obtain four critical elements of animal biology; 1) spatial location; 2) animal behaviour; 3) energy expenditure and 4) environmental conditions. Home range size, daily behaviour budgets, foraging ecology and energy expenditure are all linked to resource abundance and habitat quality (Barraquand & Murrell, 2012), and therefore can be used as a proxy for a species ability to survive and exploit resources effectively in an area. We will use these biological elements to provide an index for assessment of habitat suitability for the highly cryptic, pine marten living in commercial coniferous plantation in the RoG.