# Supporting Information 1

## *Ex-situ* estimation of REM parameter validation

Studies utilising the REM have largely estimated the maximum zone of detection parameters by means of operator camera activation (Rowcliffe *et al*, 2008; Manzo *et al.,* 2011; Anile *et al.,* 2014; Carbajal-Borges *et al.,* 2014). However, refinement of the method led to the zone of detection being derived from individual detections, i.e. the mean position of each animal at the point of first detection (Rowcliffe *et al.,* 2011). To record these data, researchers must either examine all recorded images *in-situ*, estimate the location of each animal in the landscape, and measure each parameter empirically, or return to the field to take relevant measurements after sorting the images *ex-situ*.

Processing camera trap data can be extremely time consuming, particularly if video footage is being recorded rather than still images. In this study, we found that the focal species (European and Irish hares) accounted for only 3.6 hours (3%) of 120 hours of video footage recorded. The study area was set in agricultural land and consisted of small fields, so it was not surprising that approximately 75% of all records featured domestic livestock. Identification of animals and measurement of REM parameters from detections *in-situ* was thus impractical given both the individual and cumulative duration of detections, and the low resolution of camera playback screens which made recognition of distant animals difficult (i.e. confusing hares with rabbits). Re-visiting sites to measure $r_i$ and $a_i$, while possible, was not considered to be practical given constraints of time and cost. To address these considerations, we developed a protocol for the *ex-situ* estimation of $r_i$ and $a_i$ from camera trap images using a modified field protocol and a simple grid system using readily available image manipulation software (see main Methods of primary report).

### *Ex-situ* parameter estimation

To simulate the location of an animal, a small metal disc was tossed into the field of view of a camera trap, and then replaced with a medium-sized backpack (40 x 27 cm) representing a hare. The camera trap was set as described in the main Methods of the primary report. Data were collected from 10 data points in each of 10 fields ($n$=100). Fields were chosen *a priori* based on subjectively-discerned differences in aspect and vegetative composition so as to mimic the variety of habitats encountered while undertaking farmland surveys. Thus, field composition included pasture, reed (*Juncus* sp.)-dominated rough grassland, and unimproved land, across a variety of aspects. The distance ($r_i$) to the backpack from the camera (given false origin coordinates 0,0) was measured from the foot of the camera mount using a tape measure. The angle ($a_i$) to the backpack from the camera was measured using a handheld compass, following Rowcliffe *et al.* (2008, 2011). A cane grid was erected and a reference photograph taken for *ex-situ* data extraction (see the main Methods of the primary report, and Fig. 1).

Comparisons between $r_i$ and $\theta_i$ measured *in-situ* and derived *ex-situ* were examined using linear regression. To establish the performance of both input datasets, densities were calculated from both *in-* and *ex-situ* data, using a range of sample sizes from groups of 10, 20, and 30 detections, selected at random. Rowcliffe *et al.* (2008) suggest a minimum of 10 detections are required for adequate performance of the REM. Thus, we used two multiples of this minimum requirement. Confidence intervals of 95% were estimated using non-parametric, resample-with-replacement bootstrapping, with 1000 iterations where the unit of variance was the number of detections, i.e. resampled according to sample group size. Data analyses were carried out using the program R (R Core Team, 2014). Temporal ($t$) and distance-travelled ($v$) parameters followed their descriptions in the Methods section of the main manuscript.

**Results**

Simulated detections were distributed throughout the zone of detection (Fig. S1a). Radial distances ($r_i$) estimated using the *ex-situ* method were significantly positively correlated with *in-situ* measurements ($F_{1,98}$= 2430.70, $p < 0.001$, $R^2 = 0.98$; Fig. S1b). There was a mean difference of 27cm (95% CI 23-31cm) between the methods. Precision declined at distances beyond 6m though the correlation remained statistically significant ($F_{1,14}$= 15.47, $p < 0.001$, $R^2 = 0.75$; Fig. S1b insert), with a comparable mean difference of 22cm between the methods but substantially greater variation (95% CI 6-38cm). *In-situ* measured and *ex-situ* estimated angles ($a_i$) were also significantly positively correlated ($F_{1,98}$= 410.57, $p < 0.001$, $R^2 = 0.90$; Fig. S1c), with a mean difference of 0.07 radians (95% CI 0.06-0.08) equivalent to 3.97° (95% CI 3.29-4.65°). Simulated REM density estimates did not differ significantly between models using *in-situ* measured and *ex-situ* estimated input parameters over sample sizes of 10, 20 and 30 detections (Fig. S2).

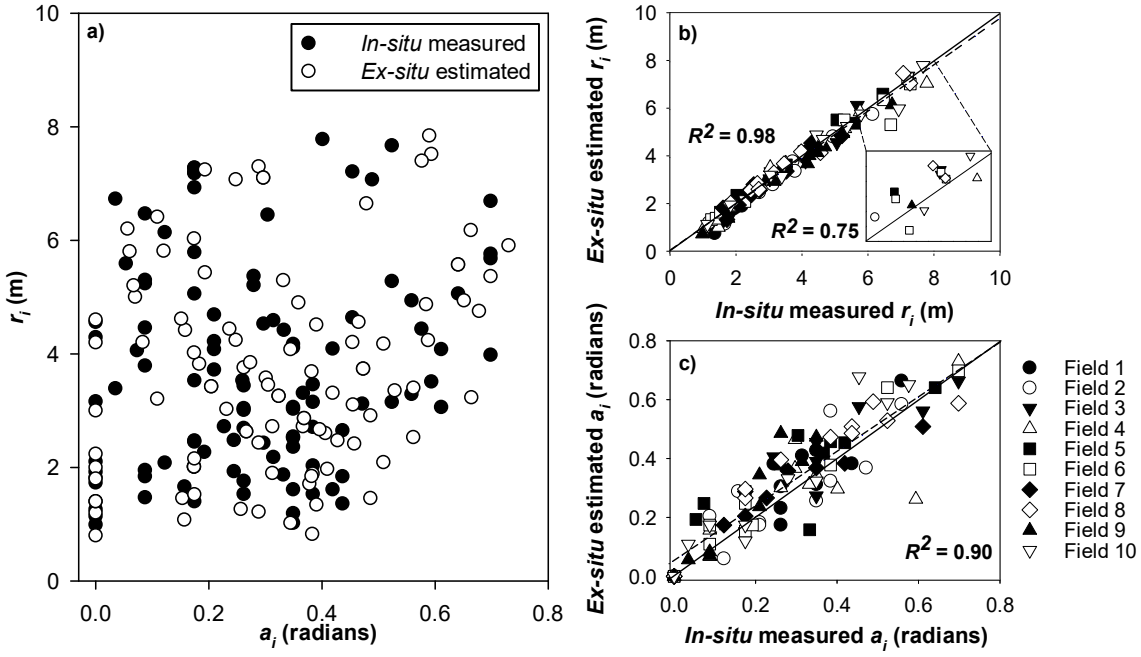


**Fig. S1** (**a**) Position of simulated detections ($n$ = 100) relative to the camera (at false origin coordinates 0,0). The zone of detection is assumed to be symmetrical; hence, this plot describes half of the sector. **(b)** Correlations between *in-situ* measured and *ex-situ* estimated. Distances $r_i$ and **(c),** angles ($a_i$) to random object placements, i.e. hypothetical animal locations. Precision in estimating radial distance begins to decline at a distance of approximately 6m (insert in b). The dashed line represents the observed regression coefficient. The solid line represents a gradient of 1, deviation from which describes inaccuracy.

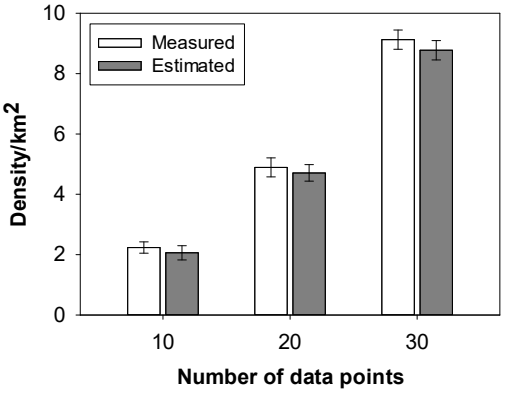


**Fig. S2** Density estimates (± 95% confidence intervals) derived from the Random Encounter Model (REM), using measured and estimated radial distances ($r$) and detection zones ($\theta$) for a range of sample sizes i.e. simulated detections.

## References

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