Source: https://unsplash.com/@satyadeep_d

Solution

A distance sampling approach to the analysis of camera trapping data offers the potential advantage that individual animal identification is not required. However, accurate animal-to-camera detection distances are required. This requires calibration prior to the survey with images of objects of known size taken at known distances from the camera. See details in (Howe et al.) for description of the field work and data analysis. Here we present analysis of data from (Howe et al.) using Distance for Windows (Thomas et al.).

1 Data input

A data set for recording of detections during peak activity are in the Distance for Windows project associated with this practical. The data themselves are in an online repository (Howe et al.)
Open the DistWin project `CTDSprac2.zip` that you have downloaded to your computer.
Glance through the data window, noting three camera stations (B1, C5, E4) had no detections.

1.1 Distance recording: binning and truncation

Distance bins are set to be narrow out to 8m, then increasing in width to the maximum detection distance of 21m.
As described in Howe et al.

> a paucity of observations between 1 and 2 m but not between 2 and 3 m, so we left-truncated at 2 m. Fitted detection functions and probability density functions were heavy-tailed when distances >15 m were included, so we right truncated at 15 m.

2 Detection function modelling

Candidate models include

- half normal key with 0 and 1 Hermite polynomial adjustment
- uniform key with 1 and 2 cosine adjustments and
- hazard rate key with 0, 1 and 2 cosine adjustments.

Note, rather than allow Distance for Windows to perform within-key function model selection of adjustment terms, we explicitly fit each adjustment term model.

3 Model criticism

Having fitted the seven models described above, examine the output of each model to assess fit. Also look at the *Results Browser* for AIC metrics.

Results browser for fitted models

Name	params	Δ AIC	D	D LCL	D UCL	D CV	GOF χ^2 p
hz key	2	0.00	14.51	7.83	26.87	0.30	0.00
hz cos1	3	2.00	14.51	7.76	27.11	0.31	0.00
hz cos2	4	3.99	14.51	7.69	27.37	0.31	0.00
un cos2	2	118.20	18.23	9.83	33.81	0.30	0.00
un cos1	1	119.85	19.25	10.40	35.63	0.30	0.00
hn hp1	2	148.29	19.73	10.65	36.57	0.30	0.00
hn key	1	203.99	22.03	11.90	40.81	0.30	0.00

4 Questions about this analysis

- Interpret the ΔAIC scores for the three hazard rate key function models.

  Hazard rate adjustment terms

  The ΔAIC scores are effectively increasing by 2 each time an adjustment term is added. This means the log-likelihood value is the same regardless of the number of adjustment terms in the model. Adjustment terms are effectively doing nothing to improve the fit of the hazard rate key function models.

- What might be justification for left truncation?

  Left truncation

  If animals close to the detector respond, detections (or lack thereof) may not be representative of the detection process. Similarly, if the vertical field of view of the detectors do not detect animals short in stature close to the detector, then left truncation might be justified.

  – What are the dangers of such truncation?

    Left truncation challenges

    The truncation distance is subjective. Remember it is detections at small distances that are fundamental to estimating $\hat{h}(0)$: slope of the PDF at distance 0. This estimate is estimated via extrapolation when left truncation is used.

- Initial assessment of fit of models?

Model fit

Note the P-values for all goodness of fit tests is effectively zero, meaning none of the models fit the data because of overdispersion.

- What is your preliminary model choice?

Model selection

Using traditional AIC for model selection, we would conclude that the hazard rate model without adjustments is the best of the candidate models for these data.

References

Howe, Eric J., et al. *Data from: Distance sampling with camera traps* [**inlang**en], 2018. https://doi.org/10.5061/dryad.b4c70.

Howe, Eric J., et al. "Distance sampling with camera traps". *Methods in Ecology and Evolution* 8, no. 11 (2017): 1558–1565. https://doi.org/10.1111/2041-210X.12790. eprint: https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1111/2041-210X.12790. https://besjournals.onlinelibrary.wiley.com/doi/abs/10.1111/2041-210X.12790.

Thomas, Len, et al. "Distance software: design and analysis of distance sampling surveys for estimating population size". *Journal of Applied Ecology* 47 (2010): 5–14. https://doi.org/10.1111/j.1365-2664.2009.01737.x.