Biological Conservation 187 (2015) 279–280

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Letter to the Editor

Data collected using the randomised response technique must be analysed using specialised statistical methods

In Biological Conservation's recent special edition on Conservation Crime, Lewis (2014) used the randomized response technique (RRT) to investigate levels of non-compliance in the North American red abalone fishery, building on an earlier study by Blank and Gavin (2009). Growth in the use of specialised questioning techniques such as RRT is a welcome development in conservation, with the potential to substantially improve understanding of illegal or otherwise sensitive behaviours by reducing levels of non-response bias and socially-desirable responding. However, the analysis of RRT data requires specialised statistical methods and researchers may unintentionally introduce a different, but potentially large, source of bias into their work if they do not analyse RRT data appropriately.

The version of RRT employed by Lewis (2014) works by replacing a proportion of responses with "noise" using a randomising device with a known probability distribution, such as a coin or die. Thus, while the researcher cannot know whether any given response reflects the respondent's true state, they are still able to obtain an unbiased estimate of the population prevalence of the sensitive behaviour by using a simple equation to correct for the noise introduced by the randomising device (see e.g. Blank and Gavin, 2009). Similar corrections must also be applied when making statistical comparisons in order for results to be unbiased. Unfortunately, however, this need for specialised statistical methods does not appear to be widely recognised, leading researchers to analyse their data incorrectly (e.g. Arias and Sutton, 2013; Blank and Gavin, 2009; Lewis, 2014). For example, although Lewis (2014) correctly adjusts the individual estimates of illegal behaviour derived from single questions, she goes on to use *t*-tests to compare her estimates against those of Blank and Gavin (2009) and to use a standard logistic regression to model the relationship between rule-breaking (i.e. RRT responses) and demographic characteristics of respondents. Neither statistical method is appropriate here, nor does the use of non-parametric statistical methods, such as Mann–Whitney tests (Blank and Gavin, 2009), or the relaxation of the traditional alpha level of 0.05 to 0.1 (Arias and Sutton, 2013), provide a solution.

Naïve statistical comparisons of RRT data produce biased results: mean estimates of illegal behaviour can be biased either upwards or downwards depending on the proportion of "yes" and "no" responses introduced by the randomising device and the true prevalence of the behaviour in the population; the standard errors associated with these estimates are underestimated; and the size of covariate effects are also underestimated. Intuitively, this occurs because a proportion of the responses are generated by the randomising device and so have no relationship to the quantity of interest. The magnitude of these biases depends on the proportion of the true responses that are replaced with noise by the randomising device (e.g. in Lewis' (2014) design half of the true responses were replaced at random, suggesting that the bias may be substantial). As a consequence, any inferences based on them may be incorrect or misleading.

Although standard univariate tests and generalised linear models (GLMs) are not appropriate, RRT data can still easily be modelled using the appropriate techniques. St John et al. (2012) demonstrated that the relationship between a sensitive behaviour (in their case, killing a protected carnivore) and covariates (such as the attitude of the respondent towards the action), can be modelled using a binomial GLM with a specially modified version of the logit link function. Rather than resort to inappropriate statistical techniques, or neglect to model the effects of potential confounding factors entirely, we encourage researchers to take advantage of this approach in their work.

Many topics that we wish to study in conservation are sensitive because they are illegal, or because people are embarrassed or reluctant to discuss them openly. Recently there have been great strides made in developing methods which overcome question sensitivity, and new research in this area continues to improve the quality of information available to conservationists. In the case of RRT, these benefits come with a small cost due to the requirement for non-standard statistical methods. We strongly encourage researchers using RRT, or other specialised questioning techniques that add noise to data, to consult with statisticians to ensure that they choose appropriate tools for their analyses rather than risk bringing the reliability of their work into question and rendering important conclusions about the efficacy of management unreliable.

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http://dx.doi.org/10.1016/j.biocon.2015.04.020

Aidan M. Keane [a,*]
Ana Nuno [b]
Freya A.V. St John [c]
[a] School of GeoSciences, University of Edinburgh, Edinburgh EH9 3FF, UK
[b] Centre for Ecology and Conservation, College of Life and Environmental Sciences, University of Exeter Cornwall Campus, Penryn, Cornwall TR10 9EZ, UK
[c] Durrell Institute of Conservation and Ecology, School of Anthropology & Conservation, University of Kent, Canterbury, Kent CT2 7NR, UK
* Corresponding author. Tel.: +44 (0)131 651 4444.
E-mail address: aidan.keane@ed.ac.uk (A.M. Keane)

Available online 9 May 2015