Biological Conservation xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Biological Conservation

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

Letter to the Editor

Making the best of camera-trap surveys in an imperfect world: A reply to Balme et al.

Big cats are wide-ranging and occur at low densities; consequently, confidence in the results of traditional camera-trap surveys is generally limited by low capture rates. However, by using bait, we recorded 645 independent detections in a single 50-day baited camera-trap survey, whilst unbaited surveys at the same site yielded only 111 detections over the same period (du Preez et al., 2014). Baiting increases capture frequency and capture probability – both of which are fundamental parameters for calculating accurate and precise population density estimates. Furthermore, our findings suggested that cubs and camera-shy individuals, which remained undetected in unbaited camera-trap surveys, were more likely to be recorded in baited surveys.

Artificially low density estimates and skewed assessment of population demography, resulting from non-detection of resident individuals, are potential biases that may impact conservation decisions. Whilst capture rates can be optimised by careful placement of cameras on well used game trails, one of the constraints of using camera-trap surveys in areas with extensive networks of game-paths (i.e. most open savannah woodlands in Africa) is that animal movement is not predictably confined to the most obvious trail. Using baits to attract leopards eliminates this unpredictability, and improves the efficiency of the survey.

In their letter, Balme et al. criticise the lack of comparison with a reference population estimate. Realistically, detailed baseline population estimates of cryptic and elusive predators necessitate costly long-term research. Few studies of leopards have the resources to generate sufficient baseline data for independent population evaluation, and the majority rely on unbaited camera-trap surveys to estimate population size and structure. This study aimed to compare the efficacy of baited versus unbaited camera surveys in revealing the underlying population structure. Because baited surveys detect a higher proportion of individuals in the study area, they provide a more complete and thus more accurate picture of the study population.

Additionally, our baited method allowed careful positioning of the camera in relation to the bait, which standardised the angle at which photographs were taken, allowing unambiguous identification and sexing of individuals. Professionals presented with photographs of known leopards could not reliably distinguish the sex of individuals or age male leopards, particularly those under two years of age (Balme et al., 2012). Therefore, whilst baited camera-traps allowed accurate sexing of all leopards detected, we did not attempt to separate sub-adults from adults. However, we included all independent individuals in the analysis, and accounted for individual heterogeneity in spatially explicit capture-recapture sub-models.

Balme et al. express reservations about whether baited surveys attract individuals from outside the survey area, thereby violating the assumption of geographic closure. Geographic closure is difficult to ensure in camera-trap surveys of wide ranging species – particularly those whose behaviour includes frequent territorial incursions. However, we argue that baited surveys are no more likely to violate this assumption than unbaited ones. As outlined in the original article, we were unable to detect changes in the home range or movement patterns of GPS-collared leopards occupying areas inside and adjacent to the survey areas (see http://dx.doi.org/10.1016/j.biocon.2014.05.021). This suggests that neighbouring leopards were not in fact lured into the survey area, and did not thereby artificially inflate population estimates.

Balme et al. are discomforted by the fear that baiting may habituate leopards, and thereby increase their vulnerability to hunters, persecution or intra-guild predation. In our study area, hunters use baits; 20 leopards are hunted annually, each hunt is a minimum of 14 days, and an average of 15 bait sites are used per hunt – resulting in approximately 4200 bait nights per season for leopard hunts alone. In contrast, each of our surveys was only 1250 bait nights. Given that leopards in our study area were routinely exposed to baits, our survey would have been unlikely to have increased levels of habituation. Indeed, habituation is a rather mute point considering how readily the leopards took to baits in a hunting area. Additionally, if there was any intra-specific or intra-guild aggression as a result of the baits, we would expect this to have been recorded by the camera-traps, which was not the case.

We could find no unequivocal evidence in the literature that leopards exhibit a strong seasonal birth pulse; and Hunter et al. (2013) state that 'births occur throughout the year' with only limited evidence for weak site–specific seasonality. Notwithstanding this, our experimental setup (consecutive baited and unbaited surveys run simultaneously across two sites, with each method alternated in the order of conduct at the respective sites) was such that had a birth pulse occurred, we should have detected this regardless of the method used. We feel that the more conservative explanation for higher detection rates of cubs is due to the use of baits rather than seasonal variation in cubs present between consecutive surveys. Whilst detection of cubs may be less important in one-off population surveys, we argue that juvenile mortality is a critical parameter in studies where more detailed understanding of population dynamics is required for conservation management, such as in populations subjected to hunting pressure or heavy persecution.

When planning surveys, researchers need to balance purpose, time, expense and rigor. We readily acknowledge that baiting is not feasible in many areas, and we would not, as Balme et al. suggest, advocate the use of livestock carcasses as bait, due to the risk of disease transmission. In our situation bait was freely available, and this made baited surveys cheap and efficient when

http://dx.doi.org/10.1016/j.biocon.2014.09.022
0006-3207/

compared to unbaited surveys. Our method revealed the potential shortcomings of traditional camera-trapping protocols, and may inform other researchers in planning and interpreting their own surveys.

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