Recommended monitoring of cattle carcasses for nephrotoxic NSAIDs in potential vulture safe zones and release areas

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Introduction

SAVE currently recommends three principal methods for monitoring the hazard/safety to free-ranging vultures in potential vulture safe zones and release areas: (1) undercover surveys of NSAIDs available for purchase for veterinary use in pharmacies; (2) sampling of liver from cattle carcasses for chemical assays of all nephrotoxic and potentially nephrotoxic NSAIDs; (3) monitoring of the survival of wild vultures after capture and tagging with GPS/GSM tags. Methods (1) and (2) require thorough and representative sampling of sites within 100 km of the centre of the vulture safe zone or the release site. In Method (3), wild vultures effectively sample the area in which the local vulture population is exposed to hazards, including both NSAIDs and other harms, so the spatial location of sampling sites is not important. Method (1) is recommended as a relatively inexpensive first step. Only if pharmacy surveys indicate that there is very little availability of nephrotoxic NSAIDs is it worth the considerable effort and expenditure involved in Methods (2) and (3). This note focusses on the number of samples required for Method (2).

Underlying logic of cattle carcass sampling programmes

SAVE recommends taking and analysing liver samples from a minimum of 800 cattle carcasses and that none of these should be found to have a lethal level of any nephrotoxic if the area is to be considered safe. The logic of this is set out below.

Suppose that the true proportion of cattle carcasses available to vultures in the study area which have a lethal level of one or more NSAIDs is denoted by *C*. If *N* carcasses are sampled and assayed for toxic NSAIDs, the probability *K* that at least one of them is found to have an NSAID concentration at or above the lethal level is given by

$K = 1 - (1-C)^N$ Equation (1).

The next thing to consider is for how small a value of *C* do we wish the cattle carcass survey to have a good chance of being able to detect at least one lethal case. Cuthbert et al. (2014) analysed cattle carcass survey data from 11 areas of India and found that the overall mean death rate per meal of White-rumped Vultures in India was 0.015 in 2005 and 0.0053 in 2009. Mean death rate per meal from this analysis is equivalent to the proportion of carcasses with a lethal level of NSAID *C*. The rate of decline of the White-rumped Vulture population in India was less rapid in 2009 than it had been in 2005, to about the extent expected from the change in diclofenac contamination of cattle carasses (Prakash et al. 2012), but the vulture population was still in decline in 2009. Hence, the value of *C* we should wish to quantify from cattle carcass surveys is less than 0.0053. Green et al. (2004) found that even a value of *C* as low as 0.001 could cause a vulture population to decline at appreciable rate. Hence, I use equation (1) to evaluate *K* for various values of *N* and for a low but potential impactful value of *C* (*C* = 0.001), the estimated value of *C* for White-rumped Vultures in India in 2009 when the decline was slowing (*C*=0.0053) and the estimated value of *C* for White-rumped Vultures in India in 2005 when the decline was still very rapid (*C*=0.015).

Consequences of choice of sample size *N*

Table 1 shows the expected probability *K* of detecting at least one cattle carcass sample with a concentration of nephrotoxic NSAID at or above the lethal level for vultures in relation to the true proportion of carcasses with a lethal level *C* and the number of carcasses sampled *N*. It can be seen that the chance of detection of a lethal concentration is quite low when the number of carcasses is 100. For N=800 the probability of finding at least one sample with a lethal level is high (*K* > 0.98) for moderate and high values of *C* (*C*=0.0053 and *C*=0.015), but lower (*K* = 0.551) for the lowest *C* value considered (*C*=0.001). With a sample size of 10000 the probability of detecting at least one cattle carcass sample with a concentration of nephrotoxic NSAID at or above the lethal level is high (*K* > 0.99) for all values of C.

Table 1. Probability *K* of detecting at least one cattle carcass sample with a concentration of nephrotoxic NSAID at or above the lethal level for vultures in relation to the true proportion of carcasses with a lethal level *C* and the number of carcasses sampled *N*.

	Value of *K* for sample size:		
C	*N*=100	*N*=800	*N*=10000
0.001	0.095	0.551	0.999
0.0053	0.412	0.986	1.000
0.015	0.779	0.999	1.000

Conclusion

This assessment shows that the SAVE recommendation of a sample size of 800 cattle carcasses gives a high probability of detecting cattle carcasses with lethal levels of NSAIDs unless the true proportion of such carcasses is low, but still potentially impactful. It should be borne in mind that the SAVE recommendation is intended as a pragmatic compromise rather than an optimal solution. Sampling the largest possible number of cattle carcasses would obviously be optimal and a sample size of 10000 carcasses per vulture safe zone/release area would be a more sensitive design. However, given the large number of NSAID compounds of known or potential toxicity now needing to be assayed and constraints on funding, which have so far largely been from charitable sources, the sample size of 800 carcasses seems to be a reasonable compromise. Certainly, sampling a small number of cattle carcasses (e.g. *N* = 100) would give inadequate protection.

References

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