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Monitoring the exposure of non-target predators to anticoagulant rodenticides - a new regulatory tool

ABSTRACT: Restrictions on SGAR use in Britain are to be relaxed but will be accompanied by stewardship designed to reduce non-target secondary exposure. Success remains uncertain. We describe a novel means of monitoring future change in exposure and risk to wildlife using barn owls as sentinels of non-target secondary exposure.

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Second generation anticoagulant rodenticide (SGAR) use in Britain

Current usage, regulatory change and stewardship

Use of second generation anticoagulant rodenticides (SGARs) in Britain in open areas is thought to present the greatest risk of exposure in non-target wildlife. Until recently, the most acutely toxic compounds (brodifacoum, flocoumafen, difethiolone) have been restricted to indoor use s to mitigate this risk; open area use has only been permitted for bromadiolone and difenacoum.

Recent regulatory review has argued there is a lack of evidence to distinguish between the five SGARs in use in Britain in terms of their risk to non-targets, and they should be treated identically. Authorisations are likely to change so all compounds can be used in and around buildings; some may be used in open areas. This change in authorisation will be accompanied by a stewardship scheme designed to enhance best practice in terms of use. Stewardship is intended to reduce exposure and risk to non-targets but success is uncertain.

Monitoring exposure of wildlife to SGARs

The Predatory Bird Monitoring Scheme (PBMS - http://pbms.ceh.ac.uk/) has been monitoring liver SGARs in barn owls (*Tyto alba*) since the mid 1980s (Figure 1).

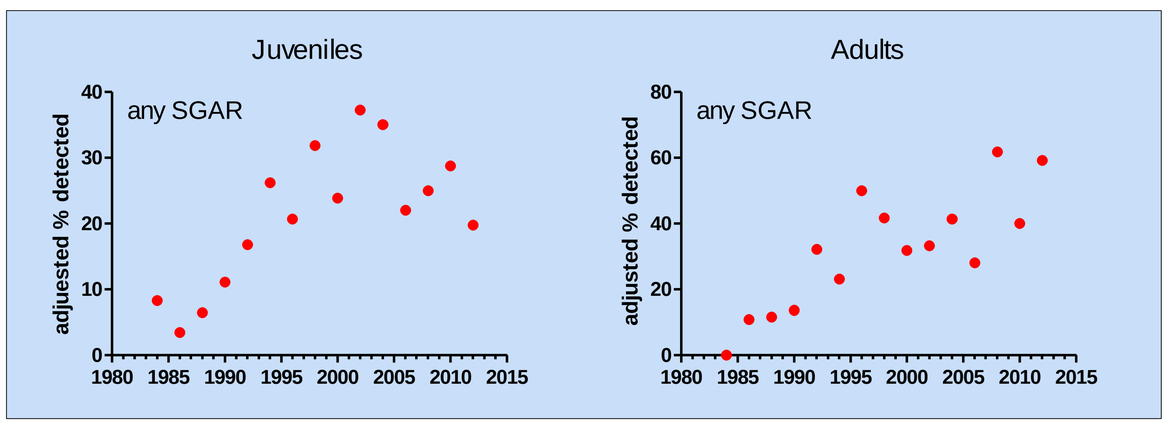

Figure 1. Long-term trends in the proportion of adult and juvenile barn owls exposed to any SGAR

The PBMS dataset on SGAR residues in barn owls can provide a baseline against which future changes in exposure (associated with change in use and stewardship) can be measured.

Our aim in this study was to determine whether, and over what time period, 5-50% changes in exposure in barn owls could be detected. Change in exposure was defined as a change from baseline levels (measured between 2006 and 2012) in annual mean barn owl liver SGAR concentrations.

Assessing changes in exposure

Skewed distributions of the residue data for each compound and for sum SGARs required data being split into::

- "low" concentrations: < 0.1 µg/g wet wt.
- "high" concentrations: > 0.1 µg/g wet wt.

"Low" concentrations reflect relatively low level exposure whereas "high concentrations" can be considered relevant in terms of acute toxicity. Mean "low" and "high" concentrations in barn owls are given in Table 1.

Table 1. Mean "low" and "high" wet weight liver SGAR concentrations in barn owls 2006-2012.

	Mean Concentrations (ug/g ww)		% Observations with concentrations (ug/g ww)	
	<0.1	>0.1	>ND	> 0.1
Brodifacoum	0.005	0.510	37.2	3.54
Difenacoum	0.011	0.140	57.0	5.06
Bromadiolone	0.014	0.194	61.5	4.81
Flocoumafen	NA	NA	3.04	0
Difethiolone	NA	NA	0.25	0
Sum SGAR	**0.024**	**0.260**	**80.8**	**16.7**

Three assessment metrics of change in exposure

- Change in "low" concentrations: (<0.1 µg/g ww incl. NDs) —bulk of the data, sensitive to change
- Change in "high" concentrations (> 0.1 µg/g ww) — toxicologically relevant
- Change in proportion of "high" and "low" residues

We found we could detect changes of 10-20% from mean "low" and "high" concentrations by analysing between 50 and 100 barn owls annually for between 1 and 4 years; power was always >70%. An example of the power analysis is shown in Figure 2

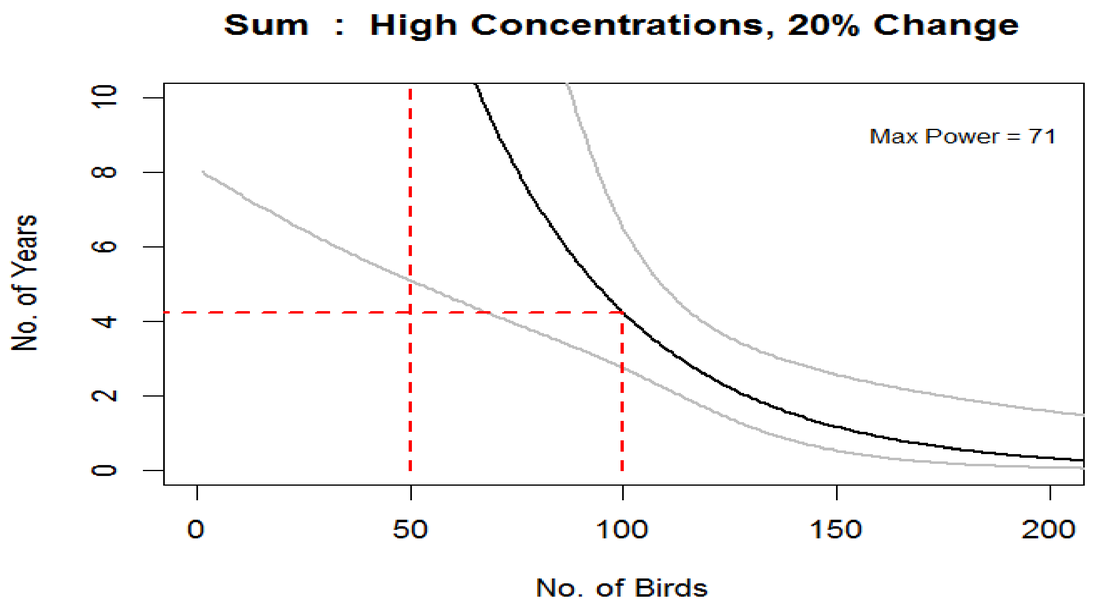

Figure 2. Relationship between number of owls analysed per year and duration of monitoring needed to detect 20% change from the mean liver sum SGAR residues

Conclusion

Our proposed monitoring of barn owls can provide a sensitive way to detect change in SGAR exposure in predators of non-target small mammals. It could be used to set targets for stewardship and as a regulatory trigger for further changes to authorisations if necessary. This study is also a good example of how splitting residue data into two distributions can enhance the power of monitoring.

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