Monitoring barn owl exposure to rodenticides: a new regulatory tool

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Predatory Bird Monitoring Scheme



RODENTICE USE IN THE UK

- Mainly Second Generation Anticoagulant Rodenticides used
- vitamin K antagonists
- non-target specific
- Widespread exposure of many non-target species



- UK: until recently, 3 most acutely toxic SGARs restricted to indoor use
- Out door use of difenacoum and bromadiolone permitted
- Resistance in target species in some areas to outdoor use compounds







UK REGULATORY POSITION ON SGARS-

- SGARs pose an unacceptable risk for primary and secondary poisoning of birds and other non-target mammals
- Use required (protect public health, infrastructure, reduce economic loss due to rodent infestations)
- No distinction among all SGARs in terms of risks to non targets
- Use of all SGARS restricted to in and around buildings (& some open area)



 Industry-led stewardship to coordinate and deliver SGAR use that minimises impacts on non-target species

POTENTIAL SECONDARY EXPOSURE OUTCOMES

- Now: In and around building use of all five SGARs (some compounds in limited open area use)
- May decrease exposure (non-target small mammals and their predators) to bromadiolone and difenacoum



- BUT may increase exposure to more acutely toxic brodifacoum, flocoumafen, difethiolone
- No known resistance in rodents to brodifacoum, flocoumafen and difethiolone, so may be preferred (compound switching)?
- BUT effect on combined exposure in non-targets (sum SGAR accumulated) could decrease if stewardship effective
- Uncertainty emphasises the need to monitor outcomes

PBMS BARN OWL MONITORING



Walker et al. (2014) Anticoagulant rodenticides in predatory birds 2012. PBMS website

- PBMS monitored exposure of barn owl (*Tyto alba*) with ~ 50 owls/yr analysed for liver SGAR residues
- Long term changes detected
- Large unique base-line dataset against which to assess the effects of change in use on non-target exposure
- But what is the power to detect change and how much analysis?



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INITIAL ANALYSIS

- Use data since 2007 when analysis by LCMSMS
- Examine power to detect change when expressed as:
 - Presence or absence of liver residues of each specific SGAR
 - Magnitude of liver residues of each specific SGAR and summed SGARs in birds with detected residues
- Key metric: number barn owls/yr up to 10 year period to detect 5%, 10%, and 20% change in exposure time
- Initial analysis: concentration better than presence/ absence data but heavily skewed
- Split data "low" concentrations (<0.1 μg/g ww incl. NDs) and "high" concentrations (> 0.1 μg/g ww)







ASSESSMENT CRITERIA

Three metrics

- 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)
- Change in proportion of "high" and "low" residues
- Statistically and toxicologically relevant
- Concentrations: brodifacoum, difenacoum, bromadiolone, ∑SGARs
- Flocoumafen and difethiolone presence/absence data
- Simulated data analysed using parametric GLMs/Chi squared tests to test for significant changes over time
- All tests had >70% power









AVERAGE VALUES

	Mean Conc (ug/g	entrations ww)	% Observations with concentrations (ug/g ww)					
	Low	High	Low	High				
Brodifacoum	0.005	0.510	34	3.5				
Difenacoum	0.011	0.140	52	5.1				
Bromadiolone	0.014	0.194	57	4.8				
Flocoumafen	NA	NA	3	0				
Difethiolone	NA	NA	0.3	0				
Sum	0.024	0.260	64	17				







BRODIFACOUM-LOW CONCENTRATIONS (0.005 µg/g ww

Brodifacoum : Low Concentrations, 5% Change

Brodifacoum : Low Concentrations, 10% Change



No. of Birds

Centre for

No. of Birds

Brodifacoum : Low Concentrations, 20% Change





SUMMARY OF TIMEFRAMES

Cmpd				Lo	w			High Concentrations							Low to High Concentrations			
			Co	ncen	trati	ions		(>0.1 ug/g ww)										
Low	No/			No. Y	Years			No. Years							No. Years			
mean	NO/ Dirda		95% CL for 10% change		95	5% CL	ώ CL	95% CL for		95% CL for		95% CL			95% CL		95% CL	
	DITUS				fo	or 20%		10%		20%		for 50%			for 10%		for 20%	
High					change		change		change		change			change		change		
mean			L	U	L	U		L	U	L	U	L	U		L	U	L	U
Brod	50		2	5	1	4		NA	NA	8	93	3	9		7	44	3	5
0.005																		
0.510	100		1	4	1	5		NA	NA	7	40	1	3		5	13	1	1
Difen																		
0.011	50		7	17	1	1		2	4	1	3	1	1		9	102	4	16
0.140	100		1	2	1	1		1	3	1	1	1	1		7	31	1	3
Brom																		
0.014	50		4	18	1	4		4	55	3	9	1	3		6	80	3	8
0.194	100		2	л	1	2		А	22	1	2	1	1		5	23	1	2
0.10 .	100		2	-	-	5				-	2	–	–			23	-	5
Sum	50		4	37	2	4		9	35	6	47	1	1		8	187	5	28
0.024																		
0.260	100		3	9	1	3		9	25	3	7	1	1		7	88	2	5

DATA INTERPRETATION

- Data "splitting" messy but has advantages
- Sensitive to low level change (bulk of data)
- Detect major changes in "toxic" range
- Must use all three metrics
- Should be able to detect "compound switching" and relate to known resistance areas









SUMMARY

 Barn owl is a sentinel for exposure through non-target small mammals



- Other exposure routes?
- Direct measure of how stewardship affects non-target exposure
- Sensitive to 20%-50% change within regulatory "acceptable" period
- Stewardship for 2015





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Questions?





SUM SGARs-HIGH CONCENTRATIONS (0.260 µg/g-ww

Sum : High Concentrations, 10% Change

Sum : High Concentrations, 20% Change



Sum : High Concentrations, 50% Change





No. of Birds