An assessment of animal welfare impacts in wild Norway rat (*Rattus norvegicus*) management

Sandra E. Baker*, Michael Ayers, Ngaio J. Beausoleil, Steven R. Belmain, Manuel Berdoy, Alan P. Buckle, Christopher Cagienard, David Cowan, Jane Fearn-Daglish, Peter Goddard, Huw D.R. Golledge, Elizabeth Mullineaux, Trudy Sharp, Alick Simmons, Erik Schmolz
*University of Oxford, Department of Zoology, Oxford, Oxfordshire, UK
*sandra.baker@zoo.ox.ac.uk

Online Resource OR16: Welfare assessment for cholecalciferol baiting; Scenario 2. Median confidence score is given.

CONTROL METHOD: CHOLECALCIFEROL POISONING UKRAT005
Assumptions

Best practice is followed in accordance with the Standard Operating Procedure UKRAT005.
Cholecalciferol baited boxes/tunnels or trays are deployed straight away. Existing food sources are removed wherever possible.

Part A: Assessment of welfare impact excluding killing method

Domain 1 Water or food restriction, malnutrition				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
Evidence Obvious existing food sources have been removed where possible. Rats tend to follow foraging trails made by other members of their colony (Galef & Buckley, 1996). If these trails are interupted and key food sources removed, then foraging success may be reduced. Together, reduced foraging success and bait shyness towards the cholecalciferol treated baits will have a mild impact under this domain.				
Domain 2 Environmental challenge				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
Evidence No impact.				
Domain 3 Injury, disease, functional impairment				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
Evidence No impact.				
Domain 4 Behavioural or interactive restriction				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
Evidence There is a mild impact under this domain. Rats tend to follow foraging trails made by other members of their colony (Galef & Buckley, 1996). If these trails are interupted and key food sources have been removed, then foraging behaviour will increase to compensate for disrupted foraging. Rats are often described as neophobic but their foraging behaviour is the outcome of conflicting motivations between curiosity (neophilia) and caution (neophobia), known as 'the omnivore's paradox' (Berdoy & Drickamer, 2007). Exposure of rats to an unfamiliar environment interferes with object recognition, and opposing drives to avoid and explore novel objects (Ennaceur et al, 2009) may have a mild impact under this domain when boxes/tunnels are first deployed.				

Domain 5 Anxiety, fear, pain, distress, thirst, hunger				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact

Evidence

Rats may experience mild anxiety because of hunger and because of opposing drives to explore novel objects (Ennaceur et al, 2009).

Overall impact
Mild impact
Confidence score = 3

Duration of impact				
Immediate to seconds	Minutes	Hours	**Days**	Weeks
			Confidence score = 3	

Observations indicate that rats take a few days to become sufficiently habituated to the presence of the boxes/tunnels, to enter these and to eat cholecalciferol baits.

Score Part A
5

CONTROL METHOD: CHOLECALCIFEROL POISONING UKRAT005

Part B: Assessment of killing method

Level of suffering				
No impact	Mild impact	Moderate impact	**Severe impact**	**Extreme impact**
			Confidence score = 3	

Time to insensibility				
Immediate to seconds	Minutes	Hours	**Days**	Weeks
			Confidence score = 3	

Score Part B
G-H

Summary of evidence

Duration

The time between cholecalciferol bait uptake and death varies between 1 and 13 days in Norway rats (2-4 days for Selontra® (EU, 2020), with acute signs appearing after 14-48 hours in rodents. Signs of poisoning are evident for several days (Mason & Littin, 2003).

Suffering

Under Domain 1, Cholecalciferol poisoning causes anorexia (with Selontra® rats stop feeding after 1-2 days (EU, 2020), leading to days without food or water and causing weight loss and likely starvation and/or dehydration (Mason & Littin, 2003). Behavioural changes could expose rats to environmental conditions outside the normal range experienced causing impacts under Domain 2. Under Domain 3, Cholecalciferol interferes with calcium

homeostasis, causing mobilisation of calcium from the bone matrix and increased uptake in the gut, leading to hypercalcaemia and calcification within organs, including kidneys and heart, and blood vessels (Mason & Littin, 2003). Osteomalacia, due to bone resorption, may occur (RRAG 2018), predisposing animals to fractures. As a consequence of these effects, poisoned animals display vomiting, abnormal breathing, severe haemorrhages, tremors, coma, other central nervous system signs and necrotic tails. Elevated levels of circulating urea, due to kidney dysfunction, and secondary to renal failure, may lead to cerebral disturbance and ataxia. Rats will exhibit poor condition, piloerection and a hunched posture (Mason & Littin, 2003). The mode of death is most likely to be acute heart or renal failure (RRAG 2018; Mason & Littin, 2003). Anorexia, and potentially starvation-related weakness, result in secondary disabling effects under Domain 4. Animals may be reluctant to move and exhibit a lack of reaction to external stimuli. Prolonged pain interferes with ability to forage and hinders escape from predators (Mason & Littin, 2003). Under Domain 5, rodents are likely to experience sickness, lethargy, weakness, listlessness, thirst and pain (Mason & Littin, 2003). Pain and nausea are also likely when renal failure causes circulating urea levels in the blood to rise and because of build-up of urea crystals in organs and joints. Bone pain and muscle weakness may occur as a result of osteomalacia. Breathlessness may occur, as calcification of lung tissue has been seen in humans (Mason & Littin, 2003; Beausoleil & Mellor, 2015) and congestion and alveolar haemorrhaging have been observed in possum *(Trichosurus Vulpecula)* lungs (Jolly et al, 1993). Animals may experience anxiety and fear because they are unable to escape or defend themselves normally. Rats may experience confusion, depression and fatigue as direct effects of hypercalaemia on the nervous system, as known in other species. There is no evidence that consciousness is reduced before the time of death (Fisher et al, 2010); thus rats are likely to remain capable of having these sorts of unpleasant experiences from the onset of poisoning until shortly before the time of death. The impact of the killing process caused by cholecalciferol poisoning is likely to be 'severe' to 'extreme'.

Summary

CONTROL METHOD	**CHOLECALCIFEROL POISONING**	**UKRAT005**
OVERALL HUMANENESS SCORE	**5G-H**	

Comments

Rats can be poisoned year-round and may breed at any time depending on conditions. Poisoning during breeding, as assessed here, could have welfare impacts for dependent pups. If lactating females are killed, efforts should be made to find any nests containing dependent pups and humanely kill them to prevent them from dying of starvation or dehydration.

Unused bait and poisoned rat carcases should be collected and disposed of in accordance with local requirements to avoid primary and secondary poisoning of non-target animals.

Bibliography

Beausoleil NJ, Mellor DJ (2015a) Introducing breathlessness as a significant animal welfare issue. New Zealand Veterinary Journal 63: 44-51

Berdoy M, Drickamer LC (2007) Comparative Social Organization and Life History of Rattus and Mus. In: Wolff, JO, Sherman PW (eds) Rodent Societies: an Ecological and evolutionary perspective. University of Chicago Press, Chicago, USA, pp 380-392

Ennaceur A, Michalikova S, Chazot PL (2009) Do rats really express neophobia towards novel objects? Experimental evidence from exposure to novelty and to an object recognition task in an open space and an enclosed space. Behavioural Brain Research 197:417-434

EU (European Union) (2020) Product assessment report of a biocidal product for national authorisation applications; Selontra® Product Type PT 14 Cholecalciferol. Case number in R4BP: BC-LS050091-32. Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products.

Fisher P, Beausoleil NJ, Warburton B, Mellor DJ, Campion M, Booth L (2010) How humane are our pest control

tools? (09-11326) Ministry of Agriculture and Forestry Biosecurity New Zealand Technical Paper No: 2011/01. Landcare Research, Lincoln, New Zealand
Galef BG, Buckley LL (1996) Use of foraging trails by Norway rats. Animal Behaviour 51:765-771
Jolly SE, Eason CT, Frampton C (1993) Serum-calcium levels in response to cholecalciferol and calcium carbonate in the Australian brushtail possum. Pesticide Biochemistry and Physiology 47:159-164
Mason G, Littin K (2003) The humaneness of rodent pest control. Animal Welfare 12:1-37
RRAG (Rodenticide Resistance Action Group) (2018) The UK Rodenticide Resistance Action Group: Response to ECHA public consultation on cholecalciferol. https://circabc.europa.eu/sd/a/0d7998e3-f58b-4678-b403-3d14d4c60b53/13_RRAG%20Cholecalciferol_03_04_18%20FINAL.pdf