

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

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Online Resource 18: Welfare assessment for cellulose baiting; Scenario 2. Median confidence score is given.

CONTROL METHOD: CELLULOSE BAITING UKRAT006

Assumptions

Best practice is followed in accordance with the Standard Operating Procedure UKRAT006.

Cellulose baited boxes or trays are deployed straight away. Existing food sources are removed wherever possible.

Cellulose baits with effective attractants are used to ensure consumption of lethal dose

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
<p><i>Evidence</i> 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 interrupted and key food sources removed, then foraging success may be reduced. Together, reduced foraging success and bait shyness towards the cellulose treated baits will have a mild impact under this domain.</p>				
Domain 2 Environmental challenge				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
<p><i>Evidence</i> No impact.</p>				
Domain 3 Injury, disease, functional impairment				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
<p><i>Evidence</i> No impact.</p>				
Domain 4 Behavioural or interactive restriction				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
<p><i>Evidence</i> 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 interrupted 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</p>				

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
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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
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Confidence score = 3

Evidence

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 cellulose baits.

Score Part A

5

CONTROL METHOD: CELLULOSE BAITING UKRAT006

Part B: Assessment of killing method

Level of suffering

No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
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Confidence score = 3

Time to insensibility

Immediate to seconds	Minutes	Hours	Days	Weeks
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Confidence score = 3

Score Part B

G-H

Summary of evidence

Duration

Data are sparse on the effects of cellulose baits on rats. According to a manufacturer’s website (no longer available, see Mason & Littin 2003), the product takes 4-10 days “to work”, with up to 5 days between pellet acceptance and death. While eleven of twelve Norway rats survived a 10-day no-choice cellulose treatment period, the other rat died on day 6 (Schmolz 2010) . In a 14-day no-choice test on black rats (*Rattus rattus*), deaths occurred 5-9 days after ingestion of attractant enhanced cellulose bait (Zhelev et al. 2013). Signs are likely to be apparent for several days (Schmolz 2010).

Suffering

Impacts under Domain 1 include progressive dehydration as water is drawn from the bloodstream into the gut lumen and is not reabsorbed into the body. Water intake also declines, probably because of gut impaction, indicating interference with the normal physiological feedback mechanism (RRAG 2018). Cellulose baits have little nutritive value and animals consuming lethal amounts will be starving. The faeces of such rats largely constitute cellulose. Animals likely die primarily of dehydration and starvation. Under Domain 2, rats may not seek shelter. Impacts under Domain 3 include hypovolemia (i.e. reduced blood volume) as a result of fluid movement from the blood into the intestinal cellulose bait. This results in reduced blood pressure, tissue ischaemia (oxygen deprivation), multi-organ failure and circulatory shock leading to death (RRAG 2018). Osmotic water transfer probably occurs into the gastrointestinal tract, leading to net movement of water from the bloodstream into the gut lumen. Water uptake is reduced, probably due to the swollen cellulose mass in the gut suppressing the thirst response (see Schmolz 2010; Zhelev et al 2013). The cellulose swells as it takes up fluid, resulting in gut distension and potentially obstruction. Severe caecal obstruction has been observed in black rats with dense faecal masses and enlarged, hard faecal balls in the bowel lumen (Zhelev et al 2013). Rats are huddled and lethargic (Mason & Littin 2003). Behavioural impacts under Domain 4 could potentially include cannibalism which has been observed in both captive rats and captive house mice (*Mus musculus*) (Schmolz 2010; Hsieh et al 2017). Cannibalism was potentially driven by starvation or thirst, but may not occur in free-ranging populations (Schmolz 2010). Impacts under Domain 5 will include gastrointestinal pain and discomfort from distension of the gut, nausea or sickness, weakness due to hypovolaemia and likely hunger due to energy deprivation (Mason & Littin 2003). Ischaemic pain and dizziness may also arise due to inadequate tissue perfusion as hypovolaemia becomes pronounced. It is not known whether affected rats are thirsty as, despite being dehydrated, drinking is reduced even when water is available probably due to interference with feedback mechanisms (RRAG 2018). Animals may experience anxiety and fear because they are unable to escape or defend themselves normally. The impact of the killing process caused by cellulose baits is likely to be 'severe suffering' to 'extreme suffering'.

Summary

CONTROL METHOD	CELLULOSE BAITING	UKRAT006
OVERALL HUMANENESS SCORE		5G-H
Comments		
Rats can be baited year-round and may breed at any time depending on conditions. Cellulose baiting 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.		
Cellulose baits without attractants are unlikely to be effective due to demonstrated low palatability. Palatability has been increased using additives in captive no-choice trials but whether free-ranging animals would take such bait is not known.		
Unused bait and rat carcasses should be collected and disposed of in accordance with local requirements to avoid primary and (although unlikely) secondary poisoning of non-target animals.		

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