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 11: Welfare assessment for cage trapping followed by a concussive blow to the head. Median confidence score is given.

CONTROL METHOD: CAGE TRAPPING AND CONCUSSIVE BLOW TO THE HEAD UKRAT002
Assumptions

Best practice is followed in accordance with the Standard Operating Procedure UKRAT002.
Rats are captured using standard single-capture, rat wire-mesh cage traps.
Traps are deployed, baited and set straight away. Existing food sources are left undisturbed.
Traps are checked twice a day, shortly after dawn and at dusk.
Note that if animals are handled the impact will be more severe.
Release of live-trapped rats is not recommended on welfare grounds.

Part A1: Assessment of welfare impact excluding killing method: trap deployment

Domain 1 Water or food restriction, malnutrition				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
Evidence No impact				
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 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) are likely to have a mild impact under this domain when cage traps 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 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	
Evidence Observations indicate that rats take a few days to become sufficiently habituated to the presence of the cage traps, to enter these and potentially become trapped.				

Score Part A1
5

Part A2: Assessment of welfare impact excluding killing method: capture

Domain 1 Water or food restriction, malnutrition				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
Evidence Some bait is provided in traps and rats will be subject to a mild impact in this domain, with short-term water (and possibly food) restrictions that are within normal tolerance levels for the species. Rats may lose bodyweight through dehydration (Pearson et al, 2003) but trapping is avoided in adverse conditions to prevent dehydration (Waudby et al, 2019) and traps are checked every 12 hours to prevent animals dying of starvation or dehydration (Mason & Littin 2003).				

Domain 2 Environmental challenge				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
Evidence Trapping is avoided in adverse conditions to prevent hypothermia which may cause loss of bodyweight (Pearson et al, 2003) or death (Waudby et al, 2019), although conditions can change over a 12-hour trap inspection period and so sufficient shade and protection from unexpected adverse weather is provided. A captured rat may be exposed to short-term damp, cold or hot conditions, depending on trap location, but these should be within their physiological adaptive capacity and represent a mild impact.				

Domain 3 Injury, disease, functional impairment				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact
Evidence Cage trapped rats may sustain minor mouth injuries when chewing on the trap in an effort to escape. Cage trapped small mammals experience increased stress levels, although covering the trap to reduce visibility for the trapped rat should reduce this effect (Bosson et al, 2012). There is mixed information on whether stress hormone levels in small				

mammals increase with length of time trapped (Bosson et al, 2012; Fletcher and Boonstra, 2006).

Domain 4 Behavioural or interactive restriction				
No impact	Mild impact	Moderate impact	Severe impact	Extreme impact

Evidence

Normal behaviour and movement are restricted by the cage, causing a moderate to severe impact in this domain. Rats may become agitated because they are prevented from conducting behaviour that they are highly motivated to perform, e.g., hiding/escaping from predators (cats or dogs) or from cannibalism by other trapped rats, foraging, moving and lactating females may be agitated by being prevented from caring for pups. In some cases, predators (raptors or terrestrial predators) may approach or even attack a trap containing a rat, but the rat will be unable to perform normal escape behaviour.

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

Evidence

Rats are likely to experience fear and distress while trapped (Mason & Littin 2003), equating to a moderate to severe impact.

Overall impact
Moderate-severe
Confidence score = 2

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

Evidence

Rats may be trapped for up to 12 hours before being found and killed if best practice guidance is followed.

Score Part A2
5-6

CONTROL METHOD: CONCUSSIVE BLOW TO THE HEAD UKRAT002

Part B: Assessment of killing method

Level of suffering				
No impact	Mild impact	**Moderate impact**	Severe impact	Extreme impact
		Confidence score = 2		

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

Score Part B
D

Summary of evidence

Duration

The time for an operator to approach a rodent in a cage trap, transfer it into a sack, apply a concussive blow to the head (CBH), and for the rat to reach irreversible unconsciousness, is likely to be a few minutes at most.

Suffering

There is no impact under Domain 1, but there may be some impact under Domain 2 as the rat is briefly held within a sack before being killed. Provided CBH is administered effectively, the rat should be rendered unconscious instantly (AVMA, 2020) and there would be no functional impact under D3. (The rat will need to be well positioned in a corner of the sack and held firmly to achieve an optimal strike when the blow is delivered.) The trapped rat will experience impacts under Domain 4 as it is unable to escape the operator when they approach and then transfer the rat to a sack and position it for killing. Trapped rats are likely to experience fear and distress during this time (Mason & Littin 2003; Prout & King, 2006), producing mental impacts (D5). Overall, the impact of the killing process is likely to be 'moderate suffering'.

Summary

CONTROL METHOD	**CAGE TRAPPING AND CONCUSSIVE BLOW TO THE HEAD**	**UKRAT002**
OVERALL HUMANENESS SCORE	**5-6D**	

Comments

This assessment assumes that the SOP is followed but if cage traps are checked less often than specified, or trapped rats not killed quickly after discovery, then impacts could be increased. Prolonged periods of being trapped will lead to dehydration, starvation, exhaustion and exposure. If cage traps were inspected much more frequently the level of distress would be reduced.

The killing and handling process is likely to take a few minutes. The skill and confidence of the operator will have a significant effect on welfare. If not performed correctly there will be varying degrees of consciousness with associated pain (Close et al 1996). Operators performing manually applied CBH must be properly trained and monitored for proficiency with this method of euthanasia. Repeatedly performing CBH can result in operator fatigue, loss of efficacy and welfare concerns (AVMA 2020).

Death should be confirmed and if necessary a second blow quickly deployed.

Rats can be trapped year-round and may breed at any time depending on conditions. Trapping 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.

Bibliography

AVMA (American Veterinary Medical Association) (2020) AVMA guidelines for the euthanasia of animals. AVMA, Shaumberg, IL, USA

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

Bosson CO, Islam Z, Boonstra R (2012) The impact of live trapping and trap model on the stress profiles of North American red squirrels. Journal of Zoology 288:159-169

Close B, Banister K, Baumans V, Bernoth E-M, Bromage N, Bunyan J, Erhardt W, Flecknell P, Gregory N, Hackbarth H, Morton D, Warwick C (1996) Recommendations for euthanasia of experimental animals: Part 1. DGXI of the

European Commission. Laboratory Animals 30:293-316
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 197:417-34
Fletcher QE, Boonstra R (2006) Impact of live trapping on the stress response of the meadow vole (*Microtus pennsylvanicus*). Journal of Zoology 270:473-478
Mason G, Littin K (2003) The humaneness of rodent pest control. Animal Welfare 12:1-37
Pearson E, Ortega YK, Ruggiero LF (2003) Trap-induced mass declines in small mammals: mass as a population index. The Journal of Wildlife Management 67:684-691
Prout DM, King CM (2006) The effect of handling under anaesthetic on the recapture rate of wild ship rats (Rattus rattus). Animal Welfare 15:63-66
Waudby H, Petit S, Gill MJ (2019) The scientific, financial and ethical implications of three common wildlife-trapping designs. Wildlife Research 46(8):690-700