

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

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Online Resource 8:

Standard Operating Procedure UKRAT006: Non-toxic lethal cellulose bait for rats

Background

Norway rats (*Rattus norvegicus*) frequent urban and rural areas and may be found on commercial, municipal and domestic premises. They cause significant economic losses, eating 25-30 g of food per day each and contaminating far greater quantities with droppings, urine and hairs. They also transmit disease, cause chewing damage and create fire hazards by gnawing electrical wires. Non-toxic lethal cellulose (CELL) bait containing powdered corn cob (PCC) is not currently authorised for use in the UK or EU and this Standard Operating Procedure (SOP) has been created only for the purposes of assessing the welfare impacts of this method.

Methods that are available for managing rats, with varying degrees of efficacy, include anti-coagulant poisons, cholecalciferol, spring-traps, live cage-traps, shooting, gassing, electrocution traps, glue traps, chemical repellents and proofing. Sonic and electro-magnetic deterrents are also available but there is little or no evidence that these methods are effective.

CELL baits are used as a non-toxic food source that kills rats by disrupting their digestive system, resulting in lethal dehydration. They are marketed as a “natural and environmentally-friendly” alternative to anti-coagulant rodenticides. While PCC was included in Annex 1 of the EU Biocidal Products Regulation (2013), and is therefore an approved active ingredient, no PCC products are currently authorised for use in the UK or EU, although such products are used in North and South America. This SOP is for killing rats with non-toxic lethal CELL bait containing PCC. This SOP is for reference only and should not be used for the deployment of bait.

Application

- The Prevention of Damage by Pests Act 1949 makes local authorities responsible for ensuring that their districts are kept free of rats (as far as is practicable). The Act also requires occupiers of non-agricultural land to notify the local authority if 'substantial numbers' of rats are living on or resorting to the land. Occupiers of agricultural land are not however required to notify the local authority regarding rats on their land. Under the Act, local authorities have the power to require landowners and occupiers to control rat infestations on their land. Where necessary the local authority can conduct the control work and recover the cost from the landowner or occupier.
- Rats will thrive where there is cover, food and water and infestations occur in diverse circumstances as a result, including farms, food processing facilities, factories, hospitals, prisons, sewers, parks and gardens, and homes.
- Rats can legally be baited with CELL baits at any time of year (provided such a product is authorised for use in the UK). Control should be undertaken promptly as soon as a problem is identified. Leaving a small infestation unmanaged may allow it to develop, increases the risk of damage and disease and makes subsequent control more difficult and expensive.
- Long-term reduction in rat numbers might be best achieved by baiting before breeding peaks, but killing females with dependent pups raises welfare issues for the pups.
- Rat management campaigns may involve the use of more than one method as a combination of methods may prove most effective. Choice of method(s) will depend on the scale of the problem, the resources available (including competence/experience of the person conducting the management) and risks to non-target animals, people and hygiene.
- CELL baits disrupt the digestive system of rats and are thought to cause dehydration, reduced blood volume and reduced blood pressure, culminating in circulatory shock and reportedly death within a few days. The manufacturer of Eradirat (no longer available as the manufacturer went out of business) claimed that "after ingestion, dehydration commences, causing blood thickening and circulatory collapse, rats become lethargic and retreat to their burrow where they lapse into a coma and die. Rats dehydrate and are mummified, usually in their burrows."
- CELL baits are not currently available in the UK.
- They can be used indoors and outdoors and are safe to use in food processing, food packing and food storage areas. They are marketed as better alternatives to anti-coagulant rodenticides for several reasons: 1) they are poison-free; 2) there is no issue of genetic resistance towards CELL baits (as there is with anti-coagulants); 3) there is no risk of secondary effects on predators that eat rats killed with CELL baits; and 4) uneaten bait will degrade naturally. It is also claimed that there are no risks of primary effects on non-target animals but there is

potential for non-target small herbivorous or omnivorous animals to eat the baits and die or suffer ill-effects as a result.

- The products are based on PCC (e.g., 40-100%), in some cases mixed with wheat flour and molasses and they are presented as a rodenticide. They are sold as ready to-use pellets, sometimes with attractants or flavours added. Unlike conventional baits, CELL baits need to form a significant part of a rat's diet to be effective, but their efficacy and mode of action are not well known. There are reports of problems with palatability and that rats tend to eat other food if this is available, but there is some evidence that palatability can be improved by the addition of attractants.
- Operators must be properly trained and competent in the use of the products concerned. Product label instructions and directions for use should be read, understood and followed.
- While CELL baits are promoted as safe to non-target animals, risks cannot be ruled out. Therefore, it is good practice, outside buildings, for bait to be adequately protected from children and as far as possible from non-target animals.
- Rats are wary of unfamiliar objects appearing in their territories, so where practical, and where this can be done safely for non-target animals, it might be better to protect and secure bait points using existing materials rather than bait boxes. This may bring rats into contact with baits more effectively and reduce the length of time for which baits need to be used and non-targets are potentially exposed to it.
- Baits must be appropriately secured. Unless you can place bait under suitable cover, or (when baiting indoors) restrict access by other species, you will need to use a secure bait box – either homemade or a commercially available tamper-resistant model.
- Indoors, rather than placing bait directly on the floor, plastic trays or other means should be used to contain bait and facilitate clearing up.
- Following successful treatment of rats, it is vital that foods are stored securely and food spills cleared up, potential harbourage is cleared, vegetation kept short around rat runs and burrows and structures proofed against access by rats; otherwise re-infestation is likely to occur.
- Revisit the site regularly to monitor for new activity/damage.

Animal Welfare Considerations

Impact on target animals

- CELL-based products interfere with rats' water absorption, causing dehydration. Reports vary but suggest that death occurs within a few days of bait ingestion. Dehydration is thought to occur rapidly and is associated with reduced blood volume (hypovolaemia) and reduced blood

pressure, culminating in circulatory shock, multi-organ failure and death. The presence of a large volume of insoluble CELL fibre in the gut probably inhibits water reabsorption from the gut back into the bloodstream and also draws water from the blood into the gastrointestinal tract. This leads progressively to dehydration and hypovolaemia. The water-swollen CELL bait in the gut lumen creates pressure on the walls of the gut, inhibiting thirst and water intake, further exacerbating dehydration and hypovolaemia. Severe bowel impaction is reported. Electrolyte imbalance may occur. Animals are reported to become huddled and lethargic in the last few hours before death, suggesting pain, discomfort or sickness. However, a 2010 study in which CELL bait was the only available food (no-choice) found that two CELL bait products were ineffective for rats, with only one of twelve animals dying within 10 days when the experiment was stopped (although the other rats were weak), despite rat faeces consisting entirely of CELL after six days.

- In contrast, in a no-choice laboratory test of two CELL baits with house mice (*M. musculus*), 44 of 46 mice were dead by day 21 of the trial but this was largely due to cannibalism, potentially indicating that the main effect of the bait was starvation (CELL baits are low in nutrients) or dehydration. The author commented that while cannibalism was not observed in trials with brown rats, such an effect may have occurred if the rat study had been continued for longer. In any case it is not known whether such behavior would occur in a free-living population, because, in a choice study, when other food was available, rats consumed insufficient CELL bait for it to have an effect. One study with black rats showed that CELL bait palatability may be improved by adding attractants.

Impact on non-target animals

- If lactating females are killed, their dependent pups will die of starvation or dehydration unless they are found and humanely killed.
- CELL baits are marketed as being of no risk to children, pets, livestock or birds. Larger animals are unlikely to be affected because they won't consume sufficient CELL bait, but there is a possibility that small herbivorous or omnivorous animals may become ill or die if they consume the bait. The effect of non-target CELL baiting may be reversible, up to a certain point.
- Predators that eat rodents killed using CELL bait will not suffer secondary effects.

Health and Safety Considerations

- The GB Biocidal Products Regulation (2021) concerns the placing on the market and use of biocidal products. It is important that users of pesticides take all reasonable precautions to

protect the health of humans, animals and plants, to safeguard the environment and, in particular, to avoid the contamination of water. Product label instructions must be followed.

- Operators must be properly trained and aware of the risks associated with rodenticide use.
- Users must satisfy the requirements of the Health and Safety Executive's Control of Substances Hazardous to Health Regulations (COSHH) for each rodenticide used, including the availability of adequate storage and suitable protective clothing. As with all pesticide use it will be necessary for users to have made a risk assessment of the compounds that they intend to use. Records should be kept of product use and its placement at the site. The requirements for protective clothing and safe working practices must be understood before treatments are carried out.
- Products must be safely stored and containers labelled.
- Rat carcasses must be disposed of appropriately.
- Rats carry diseases that may be harmful to humans and other animals (including Leptospirosis [Weil's disease], Toxoplasmosis, Hantavirus and Salmonella). The Health and Safety at Work Act 1974 makes employers responsible for the health and safety of their employees, including managing the risk of rats transmitting disease. The COSHH regulations require employers to make sure an assessment is conducted to identify risks to human health arising from rat-borne diseases. Operators should be protected by tetanus immunisation.
- Good personal hygiene is encouraged when handling baits and rat carcasses. Routinely wash hands and other skin surfaces if contaminated with faeces, blood and other body fluids and after handling baits. Cuts and grazes should be treated and covered with a waterproof dressing and waterproof gloves should be worn, together with any additional protective equipment specified on the product label.

Equipment Required

Baits

- CELL baits.
- Small plastic freezer bags, bait trays, boxes or containers as required.

Other Equipment

- Personal protective equipment as required.
- Waterproof gloves.
- Heavy metal or heavy wooden blunt implement for killing any baited rats that are discovered alive.
- Suitable waterproof bags for carrying rat carcasses and any collected uneaten bait.

Procedures

Surveying for rat activity

- Effective rat baiting relies on locating rat runs and nesting areas. Before deploying baits, carry out a survey to determine where rats are living, feeding and drinking and the routes they take between these places. All areas of activity must be identified to minimise the risk of reinvasion. All buildings and surrounding areas, including contiguous hedgerows and ditches should be surveyed.
- Key features to look for include holes/burrows (6-9cm diameter), runs (5-10cm wide through vegetation or along linear features – greasy marks may be left where rats contact hard surfaces), droppings (15-20mm long, flat at one end and pointed at the other, moist when fresh), damage (chewed/gnawed materials, e.g. food stuffs, edges of doorways and holes, wooden features, electrical wiring), footprints/tail marks in soft mud/dust/bulk grain, sightings of live/dead rats and a musky smell.
- The survey should also seek to establish any particular risks or likely problems, e.g., risks to non-target animals, hygiene failings and structural faults.

Environmental assessment

- An environmental assessment to consider the possible threats to wildlife and domestic animals should be undertaken and documented whenever rodenticides are used, particularly in outdoor locations. This must include any specific risks identified and the measures that are being taken to minimise adverse effects on non-target species. This should be regularly reviewed during the course of the programme and documented. A record of the assessment should be retained.

Deployment of baits

- Wear gloves for operator protection and to help mask human odours.
- Bait boxes or trays that are to be used may be deployed without bait a few days in advance of beginning AR treatment in order to facilitate habituation by rats; alternatively, CELL baited boxes or trays may be deployed straight away. Existing food sources should be removed wherever possible.
- Before embarking on a baiting programme, read the product label carefully to ensure that the correct, legal and safe procedure for that specific product is followed and to check the quantities of bait to be laid, the number and frequency of bait points.
- CELL baits should be bagged up in 50g or 100g plastic freezer bags or placed in small bowls for deployment.

- Careful placement of baits is crucial to maximise effectiveness. Baits should be placed in areas of obvious rodent activity, such as on runs, near active nests or droppings. Inside buildings, attention should also be paid to ledges, beams, partitions, bases of walls, conduits, false floors and ceilings. Outdoors, bait stations may be placed in hedgerows, ditches or other habitat features if the label allows. Outdoors or where non-target access is a risk, baits should be well protected. Badgers, foxes and dogs are capable of overturning bait boxes and this risk should be reduced by securing bait boxes in position.
- Sufficient bait points should be established at appropriate locations that will cover all areas of rodent activity (following bait label instructions) but accounting for potential restrictions including hazards to non-target species, risk of contaminating sensitive areas (e.g. food preparation areas), adverse conditions and where baits will be regularly disturbed or eliminated.
- Baits must be placed so that they are not accessible to children, domestic pets, livestock or wildlife larger than the target. Inspect baits regularly; any spilled or exposed baits should be removed and disposed of safely.
- Where possible, contamination by dust or moisture should be avoided.
- Always keep a record of the product used, the quantity of bait laid and where this has been placed. A simple site plan indicating the location of bait points will help to keep track of the treatment.
- Bait points should be checked regularly and topped up as necessary. Replace any baits that become damp or wet and replenish depleted baits. If bait is allowed to run out, become unpalatable, or there are insufficient bait points, then control is likely to be unsuccessful. Keep a record of bait inspection/replenishment visits too.
- Although CELL baits should not be harmful to the environment, any remaining bait should be removed at the end of treatment and records updated to indicate that the infestation is controlled and that as far as is reasonably practical all steps have been taken to ensure that the site is free of rodenticide bait.
- Once effective rat control has been achieved this can be replaced by a prevention strategy.

Humane killing of baited rats

- Any rats that are found alive but suffering the effects of CELL baiting should be killed quickly and humanely using an appropriate method.
- The most suitable technique for humane killing in these circumstances is destruction of the brain with a strong and accurate CBH using a suitable implement.
- The operator should approach affected rats alone and carefully to minimise panic and further stress to the rat.

- Kill the rat swiftly, by striking the back of the rat's head accurately and strongly with a suitable heavy and blunt instrument.
- Death of the animal should always be confirmed by observing the following:
 - o Absence of rhythmic, respiratory movements;
 - o Absence of eye protection reflex (corneal reflex) or 'blink';
 - o A fixed, glazed expression in the eyes; and
 - o Loss of colour in mucous membranes (become mottled and pale without refill after pressure is applied).
- If the animal is not dead then repeat the killing method at once. Use a secondary method to ensure death (cervical dislocation, exsanguination, destruction of the brain) before disposing of the carcass.
- Personnel performing manually applied CBH must be properly trained and monitored for proficiency with this method of humane killing. No more than a few animals should be killed in this way at one time.
- If lactating females are baited, efforts should be made to find any nests containing dependent pups and humanely kill them, to prevent them from dying of starvation or dehydration.

Collection and disposal of rat carcasses

- Rats can carry infections that are dangerous to humans and other animals. Wherever rodenticides are used, it is a requirement that rodent carcasses are regularly collected and disposed of. Other animal carcasses should also be dealt with in this way. Carcasses must be disposed of safely. For further advice contact your Local Authority.

Further information

- Contact Natural England's Wildlife Management Advisors for more information and advice on site assessment and monitoring of rat numbers.

References

Defra (2009) *Code of Practice for the prevention and control of rodent infestations on poultry farms*. Defra.

<http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000HK277ZW.09IRTYFX9O213FR>

Defra (current as at 19/11/20) *Integrated rodent management*. The Agriculture Document Library.

<http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000HK277ZX.0AX7KTDRJHU4CV>

- Defra (current as at 19/11/20) *Safe Use of Rodenticides on Farms and Holdings (HSE AIS31)*.
<http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000IL3890W.17UT6UGQ7A87IB>
- HGCA (Home-Grown Cereals Authority) (2012) *Rodent control in agriculture – an HGCA guide*.
Second edition. HGCA and Agriculture and Horticulture Development Board.
- Mason G & Littin K. (2003) The humaneness of rodent pest control. *Animal Welfare*, **12**:1-37.
- Natural England (2012) *Rats: options for controlling infestations. Technical Information Note TIN057*. Natural England.
- Natural England (2012) *Rats: control on livestock units. Technical Information Note TIN057*.
Natural England.
- Natrocell (current as at 19/11/20) Eradirat; directions for use. <http://www.pest-control-warehouse.co.uk/eradirat-rat-killer.html#backofpack>
- Schmolz, E. (2010) Efficacy of anticoagulant-free alternative bait products against house mice (*Mus musculus*) and brown rats (*Rattus norvegicus*). *Integrative Zoology*, 1: 44-52.
- Universities Federation for Animal Welfare (2008) *Guiding principles in the Humane Control of Rats and Mice* (section 6.2.1. Anti-cogulant rodenticides). <https://www.ufaw.org.uk/rodent-welfare/rodent-welfare#options>. UFAW.
- Zhelev, G., Lyutskanov, M., Petrov, V., Mihaylov, G., Marutsov, P., Koev, K., Tsvetanov, T.S. (2013) Efficacy of a cellulose-based rodenticide for control of warfarin-resistant black rats (*Rattus rattus*). *Bulgarian Journal of Veterinary Medicine*, 16, Suppl. 1, 134–140.