Code of Practice

For the prevention and control of rodent infestations on poultry farms

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Contents

Executive summary

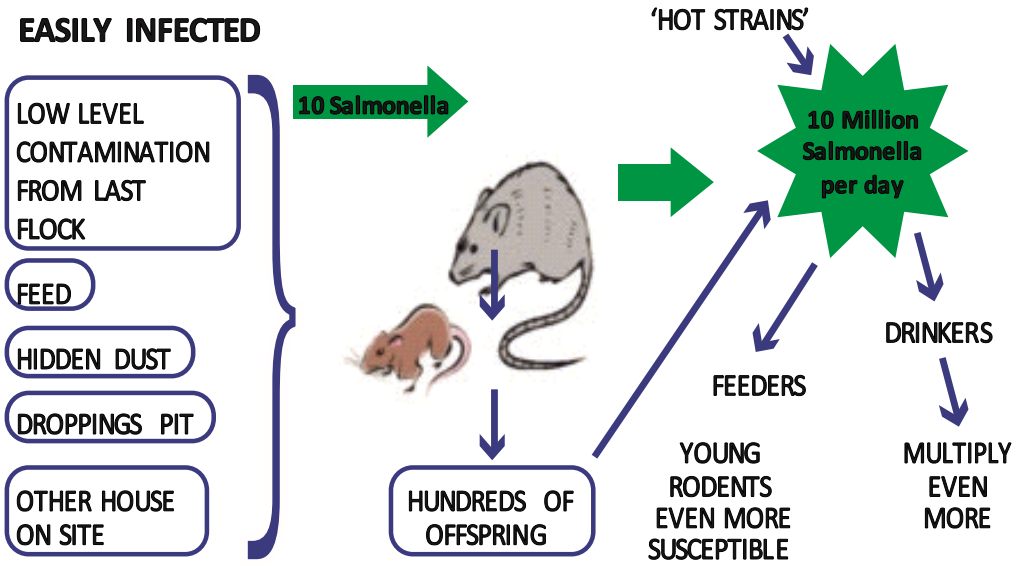
1. When rodents are present either around or within poultry facilities, they are a significant threat to biosecurity. They can harbour and transmit pathogens to poultry and subsequently to consumers of meat or eggs (in the case of foodborne organisms), and farm staff. This includes *Salmonella*, *Campylobacter*, *Leptospira* and Hantavirus.
2. Rodent infestation is always better prevented in the first place than removed once established. Therefore, the surroundings of the facility should be free from areas that might provide harbourage for rodents. Buildings should be proofed as far as possible against rodent ingress and the whole farm operation should be conducted in a way which ensures attention to cleanliness and tidiness is maintained to deny rodents access to food and water, as far as is practicable.
3. A regular system of vigilant inspection should be applied both around and within poultry rearing and service facilities so that early signs of the development of infestation can be identified. It is always easier and less costly to remove a small, developing rodent infestation than an established substantial one.
4. Operations to remove infestations always require a systematic and integrated approach, whether applied by an external pest control contractor or by farm staff who are appropriately trained and competent. Each aspect of the rodent control program must be carefully considered before implementation and regularly reviewed in relation to ongoing observations. Appropriate records of rodent activity, bait take and other control measures should be kept.
5. The concept of a risk hierarchy should be applied to rodent control operations. Within this, the various risks of the different methods under consideration, employing both non-chemical and chemical means, must be assessed and the least severe method, in terms of animal and environmental welfare, or combination of methods, applied that will achieve desired results.
6. This guidance document provides detailed advice about each element and stage of an integrated rodent management strategy, so that those who operate facilities for the production of poultry meat and eggs can protect the health and livelihoods of farm staff, the economic operation of the facility and ensure that their products meet the requirements of the businesses they supply in order to protect human and food animal health and well-being.
7. To assist with this guidance a summary checklist and audit form have been provided. It is advised that you complete these in order to assess whether your current rodent control practices are fit-for-purpose, and to identify where improvements may be needed.

Introduction

Rats and/or mice are commonly found in or around poultry units. They both pose several problems, including a threat to *Salmonella* control and food and feed safety. There are

many legal, animal welfare, human health and economic reasons why controlling rodents on poultry farms is important including:

- Rodents can carry other infections relevant to poultry health such as fowl cholera and avian influenza that can be spread to poultry;
- Rodents can also carry zoonotic[1] infections such as *Leptospira* and Hantavirus which pose a risk to the health of farm staff and other people visiting the farm;
- Rodents cause damage to farm buildings and poultry houses, including damage to insulation, which may lead to chilling of birds or reduced ventilation and to electrical installations, which may result in fire risk; and
- Large rodent populations consume a substantial amount of poultry feed and can cause feed spoilage.



The Importance of Rodents in the spread of *Salmonella*

[Note: Free-living rodents in the wild very rarely carry Salmonella – they are often infected on the farm by birds or other farm animals on the site. Research findings in several countries, especially the UK and USA, have confirmed that rodents play a major part in the maintenance of Salmonella infection on poultry farms, and in the spread of infection between poultry houses and to nearby farms.]

Management of rodents is important in Salmonella control because they can act to maintain and amplify infection on a poultry unit –on many units Salmonella may clear from flocks of mature vaccinated birds if rodent infestations are eliminated. This is a better

[1] Zoonotic diseases are diseases transmissible from animals to humans

option than waiting until the end of lay before trying to eliminate Salmonella, as new birds placed in a contaminated house just before point of lay are very susceptible to infection from existing rodent infestations.

Rodents can be infected initially with a low dose of Salmonella from the environment (so low that it would not normally infect the birds directly) which then multiplies, resulting in the rodents shedding millions of organisms per day in their droppings at the peak of infection. They can also remain infected for months. Because rodents can produce so much Salmonella, the protective effect of flock vaccination is likely to be overwhelmed, so that even well-managed flocks (which have been properly vaccinated) may still become infected. Viable Salmonella organisms may still be found in rodent droppings several weeks after the droppings are shed.

A systematic and organised approach to prevention of rodent infestations (and to the effective eradication of rodents if they become established) should be an essential part of the poultry unit and flock management. If the rodent control strategy is to be successful it must be carefully planned, operated continuously and have adequate resources committed to it.

When Salmonella is known to be present on a poultry site, it will be necessary to eradicate all resident rodents from positive houses and ensure that there are no breeding rodent populations on the unit if control of infection is to be successful.

Aims of the Code

The Code of Practice provides information and guidance for flock owners, managers, farm staff and their advisers, with the information necessary to:

- **Quantify the significance of rodent infestation problems.**
- **Identify the need for preventative measures.**
- **Enable the planning of control strategies.**
- **Assist with the implementation of control action.**
- **Ensure compliance with the relevant pesticide and other legislation.**
- **Ensure that all appropriate and available risk mitigation measures are applied during control action.**

The overall aim should be to prevent rodent infestations becoming established in the first place. This is done by combining control measures based on proofing, site tidiness and - where feasible - denial of rodent access to food and water, with regular monitoring and appropriate control programmes. The control strategy will vary according to whether action is needed whilst the poultry are occupying the buildings or at the end of the cycle when depopulation, cleansing and disinfection is carried out.

A combination of good management, site tidiness/hygiene and proofing measures will make a valuable contribution to the long-term prevention of rodent infestations and also enhance the biosecurity of the site.

Two rodent species are most likely to cause problems in poultry units – the house mouse, *Mus musculus* and the brown or Norway rat, *Rattus norvegicus*.

In the context of *Salmonella* control, both the house mouse and the brown rat are important due to their habit of living near poultry flocks and ability to move within and between buildings and structures. The favourable environment found in poultry units encourages breeding populations of rodents and can rapidly lead to high population levels if not adequately controlled.

The two species vary considerably in their physical characteristics and behaviour and, where appropriate, they are dealt with separately when this is relevant to the choice and application of control measures.

A general Code of Best Practice for the use of rodenticides in a wide range of scenarios, including on poultry farms, is provided by the Campaign for Responsible Rodenticide Use (CRRU) UK (https://www.thinkwildlife.org/downloads/). Compliance with that code is a legal requirement of the labels of all authorised rodenticide products sold to professional users.

Significance of infestation

Transmission of disease

Rodents are capable of transmitting diseases to both humans and livestock. They are easily infected by *Salmonella* and can carry and shed high numbers of organisms into the environment, particularly in droppings. Other serious zoonotic pathogens are also passed in the urine and may be carried on rodents' feet or fur. Therefore, rodent infestation may be an important means of spread of pathogens and persistence of infection within poultry units.

Although free-living rodents rarely carry *Salmonella*, their main involvement is to maintain infection acquired from an infected flock during the depopulation period and so spread it to replacement birds, and in some cases to other houses on the site. Rodents may also carry *Salmonella* into poultry units from other poultry units or nearby pig or cattle farms. At the end of the lifespan of an infected poultry flock it is normal to cleanse and disinfect the house to eliminate *Salmonella*. If infected rodents remain, they will rapidly re-contaminate disinfected surfaces and equipment. The replacement birds coming into the house will then become infected. Rodents may also disperse into other houses on site during clean out, or into the environment depending on the time of year.

Rodents may become infected after exposure to low levels of contamination in feed or dust in inaccessible places inside or around the house, which would not normally infect the birds. However, the ability of rodents to both reach such inaccessible places and to multiply *Salmonella* may then lead to infection in the flock. Some strains of *Salmonella*

transmitted by mice have also been shown to become more infectious for birds and more likely to be found in egg contents, not just on the shell.

Salmonella bacteria are persistent in rodent droppings and therefore the introduction of materials to a poultry farm (such as bedding which may contain rodent nests and droppings, or feed ingredients) can spread *Salmonella* from an infected site to an uninfected one.

Damage to buildings and equipment

The gnawing abilities of rodents will threaten the structure of buildings, thermal insulation and any other vulnerable materials. Damage to cable insulation can lead to risk of electrocution, fire hazards and may contribute to power and equipment breakdown, including ventilation systems and feed-handling facilities.

Contamination of feedstuffs

Rodents can consume significant quantities of expensive compound feedstuffs when large populations are present. Contamination by rodent urine and droppings may reduce feed palatability and increase the risk of infection and disease.

Quality standards

The presence of rodents compromises the quality standards required by farm assurance schemes. Pest-free status may be a scheme membership requirement and is also required by distributors, retailers and ultimately, the general public. It is also a requirement of the food hygiene legislation[2] that all keepers of poultry take measures to prevent pests, as far as possible, from causing contamination.

[2] The Food Safety and Hygiene (England) Regulations 2013; The Food Hygiene (Scotland) Regulations 2006; and The Food Hygiene (Wales) Regulations 2006.

Biology and characteristics

Basic requirements

Several factors affect the successful establishment of rodent populations and influence the level of infestations. The effective removal of any of these requirements will reduce the capacity of the site to support rodent infestation.

Rodents need:

a) Food
b) A safe environment (i.e. harbourage in areas such as droppings pits, storage areas, wall or roof cavities and other undisturbed or protective locations in and around poultry houses.)
c) Breeding sites
d) Water.

The habitat offered by the typical poultry building often provides optimum conditions for rodents. The enclosed constant temperature-controlled environment within poultry houses also provides freedom from predators.

Rodents have virtually unlimited access to high quality, nutritious feedstuffs that can be obtained directly from feeders, conveyors or open hoppers, and from spillages.

Fresh water is also constantly available. Although house mice do not require a free moisture source in order to survive, they will exploit such supplies, including leaks and puddles, especially when breeding.

Wall cavities, insulation layers, roof spaces and voids created between floors and other sections of the building structure will generally provide a safe environment for breeding rodents. Rats will also often occupy outdoor locations, adjoining buildings and other structures before moving into houses. These locations include accumulated rubbish, stored materials, patches of vegetation and ditches, banks or hedgerows. Mice may also behave in this way on some units where there is insufficient harbourage within the houses.

Droppings stores, mini-pits and slatted areas also provide cover for mice and rats that will burrow and live within accumulated manure if it is relatively dry. The presence of feathers and litter in manure provides ideal nest materials.

In barn and free-range units, it is common for the location of automated nest boxes to provide protection for mice, which then move around below nest boxes, on egg belts, manure belts, on top of partitions and ledges or inside conduits. Exit points for manure and egg belts from houses offer easy access for rodents.

Living and movement patterns

Rats and mice live in family groups and will defend their territories against intruders. However, there are differences between the two species that need to be understood in the context of controlling infestations.

House mouse

Mice will generally occupy the structure of the building, although they can also be found around perimeter areas, especially if the outside of buildings and storage areas are not kept tidy and/or properly baited. They may also be found, less frequently, in hedgerows, banks or other adjacent habitats.

Mice occupy small territories, which means that many discrete family groups may exist within typical harbourages, such as droppings pits and wall roof spaces, and these will live independently of each other. When the population density is high, and food and water are readily available the territory occupied by each individual group is smaller. For example, several family groups may be found in accumulated dry manure, beneath slats or large items of equipment placed on litter (e.g. in older style straw-based housing systems).

Brown rat

Rats may be found both indoors and outdoors. They may live within buildings or other structures, in areas around sites and will often excavate burrows. These can occur around the perimeter of buildings or in nearby ditches, hedgerows and the cover provided by rubbish, equipment or other materials. Drainage systems or other similar structures such as ducting are also used. They will establish regular runs from where they are living to sources of food. These outside areas act as ‘staging posts’ from which the rats that have initially been attracted by spilled feed or broken eggs, will subsequently move into houses and find harbourage there.

Rats will move into farm buildings in larger numbers in the autumn and winter when the weather is cold and wet, with outdoor food less readily available following harvest. This is important regarding the timing and planning of control measures – which should therefore be intensified and targeted at potential entry points, such as manure and egg belts or badly fitting doors, at these times of the year.

Rats and mice will readily move from a location when disturbed and the removal of food sources and cleaning of units will encourage them to seek alternative sites. This may encourage the spread of rodent populations resulting in the possibility that infection could be introduced into previously clear neighbouring units.

Although the objective should be to rapidly eliminate rodent infestations during the life of a flock, inadequate emphasis on rodent control during turnaround periods can allow remaining rats and mice to survive while they are protected within the structure of buildings or holes in areas surrounding poultry houses. They then form the nucleus of

future infestations and may be a source of carry-over for *Salmonella* infections. Rats from depopulated houses are also more likely to move to adjacent houses or neighbouring sites, with a consequent risk of spreading *Salmonella.*

Behavioural characteristics

As rats and mice vary considerably in their general behaviour and feeding patterns, a variety of deterrent and rodenticide baiting techniques are needed. Often these need to be applied simultaneously.

Mice:

Mice live in small social groups and their erratic feeding behaviour results in them visiting several different food sources during periods of activity. Consequently, it is necessary to provide an adequate number of bait points in places where rodents are living or moving.

It is also important to move the baits regularly within territories to maintain the interest of mice and to make sure that the bait is palatable and being well taken, as tastes for different types of bait may vary between farms.

Bait should also be kept fresh, free from dust and dampness and placed where the rodents are nesting and travelling – not just in set baiting points. This will often involve creating covered access points in walls, roof spaces, mini-pits, etc. in which to place bait and tamper-resistant bait boxes. Access points to houses such as the entrances of manure and egg conveyors, doors, drains and low-level vents should also be baited.

Rats:

In contrast, rats exhibit behaviour known as ‘new object reaction’ or neophobia. This makes them suspicious of anything introduced into their territories and, as a result, it may take several days before they are prepared to investigate such items.

In practice, this often means that they are slow to explore bait boxes and trays, and to start feeding on rodenticide baits, especially when the rats are already established within poultry houses before baiting is introduced or intensified.

For this reason, it is best to allow at least two to three weeks for rats to get used to feeding in bait boxes placed in their environment, before deciding on whether the method being used is working. This should be assessed by regular monitoring of bait consumption and rat activity.

Both rats and mice can gnaw a range of materials including concrete, wood, soft metals and plastics and can create gaps below house doors to gain easy access. They can climb vertical, relatively smooth surfaces such as brick walls and cross structures such as horizontal wires and cables. They can pass through very small gaps, and can jump significant distances and burrow in soil or other materials. They are also able to swim.

Rodenticide resistance

The existence of so called ‘super’ rats and mice, which can survive doses of a particular rodenticide that would normally be expected to kill them, is often quoted as a reason for treatment failure.

However, it is also possible that factors such as poor techniques in application, positioning of bait points, insufficient monitoring of baiting measures and a failure to properly follow the instructions on product labels can be involved in ineffective control.

Nevertheless, genetic resistance to several anticoagulant compounds is present in some rat and virtually all mouse populations and such resistance is becoming more widespread across the country.

It is important to understand that rodents are born either susceptible or resistant and cannot acquire this characteristic during their lifetime, although rodent populations may become behaviourally less likely to take bait, if bait runs out and individuals that have not been killed recover.

Resistance to the first-generation anticoagulants and to two of the less potent second-generation anticoagulants, bromadiolone and difenacoum, is widespread in house mice and so the use of either of these compounds is not recommended for use against this species.

The situation regarding rats is less clearly defined and confirmed areas of resistance to second generation anticoagulants have been identified in various parts of the country, particularly across central southern England where a particularly severe form of resistance is prevalent. Where there are problems with the efficacy of anticoagulant baits, either a more potent second-generation anticoagulant or the use of non-anticoagulant rodenticide baits (such as cholecalciferol) or traps can be used but trapping alone is not likely to be effective for established rodent populations.

Cholecalciferol baits may be used against Norway rats, black rats and house mice, including resistant strains. Cholecalciferol is not persistent in the environment and therefore it may be assumed to present a lower risk of secondary poisoning. However, it is not free from risks to non-targets as it is, like many rodenticides, acutely toxic to some species.

Guidelines for use in the control of resistant populations of house mice and brown rats specific to the UK are available from the Rodenticide Resistance Action Group (https://bpca.org.uk/about/partners/rrag). Information about the known distribution of resistant rat and mouse populations in the UK is provided by the Rodenticide Resistance Action Committee in the form of interactive maps (https://guide.rrac.info/resistance-maps.html).

A programme for testing rodent tissue samples for DNA mutations that result in anticoagulant resistance is currently operated by the Animal and Plant Health Agency

(APHA) and the Campaign for Responsible Rodenticide Use (CRRU). Using appropriate methods of tissue sampling, packing and postal labelling, samples may be sent to APHA by those who wish to know the resistance status of rodent infestations on their premises. Results are reported back to those who submit samples and recorded on a national database. Further details of these procedures are given by CRRU (https://www.thinkwildlife.org/free-rodenticide-resistance-testing-from-crru/).

Site assessments

Inspections and surveys

Before control action is taken, a full survey of the site should be carried out with attention paid to vulnerable or potential rodent-infested areas. This procedure takes time and effort to be done properly but failing to do it is a false economy. Any survey should be carried out by competent personnel, repeated periodically and maintained in order to monitor the situation. It includes asking farm staff about their sightings of rodents and signs of rodent activities, as well as performing a detailed visual inspection of the premises using a suitable torch.

In addition, the performance of existing treatments against current infestations should be checked to enable a prompt response to any new problems. Inspection must include all buildings and structures within the unit and any outdoor locations and habitats such as the surroundings of houses – looking for possible entry points and signs of rodent activity in storerooms, workshops, beneath stacked equipment or materials and around boundary hedgerows, banks and ditches.

Regarding rats, it may also be necessary to check for the possibility of animals moving in from neighbouring properties. Where baits are already deployed in tamper-resistant bait boxes, it is important to have the necessary key to assess whether bait boxes are being properly used and if bait is being taken.

The objectives of such an inspection are to:

- Identify the species of rodents involved.
- Assess the distribution and level of infestation.
- Identify where rats and mice are living, travelling and feeding.
- Identify any factors which might have an influence on control action, such as specific risks to human health and non-target animals, including stock and wildlife.
- Identify deficiencies in proofing, site tidiness and hygiene measures.

The annex at the end of this code provides a simple audit form which may be of assistance in assessing actual or potential rodent-related problems.

Inspection procedures

It is valuable to carry out inspections at night, when movement of live rodents, particularly rats, is most likely to be seen. Night-vision motion sensor cameras can be useful for this.

All holdings should maintain a “pest book” in which rodent sightings and other relevant information are recorded. This should be checked whenever an inspection is made.

Each area should be systematically inspected for signs of rodents or any other aspects relevant to control activities and these findings should be noted. A plan of the main buildings and features within the site and a sketch of the internal structure of each unit, will help to ensure that accurate details are recorded.

This information can then be used when control treatments are undertaken, and baiting points need to be identified. All levels of the building should be considered, including manure and service pits and drains, manure and egg belt channels, protected areas within poultry houses that birds cannot access, walls and wall voids, equipment (e.g. box feeders, slave feed hopper areas, areas beneath enriched cages or multi-tier nest boxes), roofs, service areas, as well as adjacent external or storage areas.

A powerful torch is essential when inspecting within buildings to check all areas including beneath slats (for burrowing activity in manure), voids, and roof spaces and where access is limited, and light levels are low. A smaller torch is useful for occupied buildings where birds may be frightened by the beam of light. In some cases, it may be necessary to remove wall or ceiling panels to identify nesting areas.

These activities inevitably involve handling surfaces, which may have been contaminated by rodents, and so suitable waterproof gloves should be worn in addition to the protective clothing required for biosecurity reasons. Other precautions are described in Section 7.

Particular attention should be paid to the following areas and situations:

Buildings

- Feed and egg stores.
- Hoppers and feeders.
- The presence of feed spillages.
- Accumulated broken eggs, feathers or dust.
- Storage areas within units, which may contain harbourage such as egg trays, boxes, bales of litter and equipment.
- Hollow walls, partitions, roof spaces or any other voids, e.g. beneath cages, nest boxes and egg conveyors, particularly where thermal insulating materials are present and visual inspection or cleaning is difficult.
- Electrical control panels, junction boxes and conduits for wiring systems.
- Tops of cages, egg belts, beams, pipes, ledges, partitions, conduits, header tank platforms, electrical control panels and other horizontal surfaces that may harbour

rodent droppings or show signs of movement. In some cases, such areas may be out of reach, or droppings concealed by dust, but these can usually be identified by close inspection aided by torch light or touch.
- Litter and areas beneath slats.
- Equipment within areas occupied by birds, such as automatic egg collection equipment and nest boxes, particularly the ends of the units and egg belts or ledges/trays within the outer housing and the floor beneath nest boxes. Chewing damage to plastic flaps is a common sign to look out for.
- Any faults in building structures which might permit rodent access, including chewing damage to doors, hatches and walls.
- Storage of materials or equipment in and around houses.
- Other access routes such as gaps beneath or around doors, fan housing, manure belts, egg conveyors and service entry points.

Outdoor locations

- Accumulations of materials and vegetation, especially close to buildings.
- Feed bins and hoppers – spilled feed and feed dust.
- External egg conveyors that provide a link between buildings or may accumulate broken egg on or beneath equipment.
- Incinerator/dead bins, generator areas, and rubbish disposal sites.
- Areas of vegetation or undergrowth.
- Drainage systems and associated equipment.
- Discharge points for manure belts and beneath associated conveyors.
- Manure and bedding stores.
- Stores for wood chip or other heating materials.
- Air handling plants.
- Drainage systems and associated equipment.
- Ditches, hedgerows or banks.
- Neighbouring sources of infestation – e.g. other livestock units, back-yard flocks/small-holdings, woodland, waste disposal sites, game cover strips and game feeding stations.

Traces and signs

Both rats and mice leave characteristic evidence of their presence and this is useful for estimating the magnitude and distribution of infestations. Rodents are largely nocturnal and so a combination of these signs must be employed in the initial assessment of infestation and when evaluating the results of control action.

It is common for rodent populations to be vastly under-estimated when based on rodent sightings alone. Therefore, other information is essential to confirm the rodent species involved and the level and distribution of infestation.

It may be useful, when conducting surveys for signs of rodent infestation, to use a torch with an ultra-violet (UV) beam. Rodent urine will fluoresce under UV light, but care is needed because some other materials will also do this.

Droppings

Rats will usually deposit droppings at specific locations throughout their territories. These are often found behind structures or objects that provide cover and security and in areas where rats are regularly moving. Droppings are approximately 12mm (1/2 inch) long, elliptical in shape and when fresh, can be distinguished by their moist, shiny appearance. Droppings allowed to remain on walkways and other surfaces used by site staff can be picked up on footwear and transferred to other areas. This can have significance for the spread of infections, including *Salmonella*.

Mice will leave droppings randomly throughout their territory, depositing them on horizontal surfaces over which they are moving such as egg belts, beams, ledges and conduits. Droppings are about three to seven mm (1/4 inch) long and spindle shaped. Areas where there are greater accumulations of droppings are normally those where mice are spending most time or passing through more frequently, and this may be above head height.

In many cases, the extent of contamination of poultry houses by rodent droppings can only be clearly observed after cleaning, when fresh accumulation of droppings in or on bell drinkers, feeders, belts, ledges and floor surfaces can be seen. A powerful torch is useful for inspection within enclosed empty buildings.

Smear marks

The natural grease on the bodies of rodents attracts dirt that will be deposited at various locations that are used regularly by rats and mice. These appear as dark marks that are commonly found in association with holes in structures, over ledges or along pipes, cables or other obstructions used by rodents. The smears may remain for long periods after they have been deposited so their presence needs to be linked to other signs of infestation to ensure that information obtained on the current status of rodent populations is accurate.

Urine pillars

Mice will urinate at specific locations and the combination of concentrated protein in the urine and dust which settles leads to the formation of small conical or cylindrical, greasy pillars that are often found on pipes, cables and ledges that are used regularly. Such signs indicate long-standing, heavy mouse infestations but they may also persist over time and so their presence should also be linked with other signs of infestation when assessing current rodent activity. The waxy nature of urine pillars renders them relatively resistant to disinfection so such areas should be especially well cleaned and disinfected.

Footprints

Prints, tail marks or tracks may be found in mud or dust at ground level or in accumulations on structures such as beams and ledges. Such signs can provide useful information on the general location and movement of rodents.

Runs and burrows

Rats will create regular, well-worn tracks in external areas that are usually found protected by cover such as vegetation or close to walls or other structures. They are often connected to burrows that have been excavated in ditches, banks or in other areas adjacent to buildings.

Mice burrow less commonly, although holes in earth floors and around the perimeter of buildings can indicate their presence, which is more likely around free range broiler housing that offers minimal internal harbourage for mice.

As mice usually live within structures, their activities can be identified by holes gnawed in panels or cladding, often at wall and ceiling intersections. Insulating materials ejected from wall panels can be a useful indicator of activity. Access may be gained via faults in areas such as concrete floors and block work. Expansion joints and drainage may also provide access points for mice.

Particular attention should be paid to wall areas around control panels or other equipment where it may be possible for mice to gain entry through holes cut for cables or other services. They may also nest beneath large items placed on litter or within or under straw bales stored in the poultry house. Chewed thermal insulation material is often associated with holes in the walls and roofs of buildings. Tunnel entrances in litter or manure pits may indicate burrowing activity by mice or rats.

Damage

Identifying gnawing of building structures or similar damage to equipment can be useful in locating and quantifying rodent activity. This can often be identified by light entering through gaps in an empty shed. It is also important to locate damage to electrical cabling because of the risks involved (electrocution/fire risk). The discovery of chewed materials found when investigating accumulations of rubbish or other vulnerable materials – such as bales of wood shavings, paper sacks or egg trays – can also provide important information on the activities and distribution of rodents.

Nest sites

Rodents will make nests from any available materials. Particular attention should be paid to hollow wall or ceiling spaces and areas where droppings might accumulate on ledges below slats or other structures and these can often reveal the presence of nests, particularly where mouse infestations are heavy.

Other signs

Reports of rodent sightings or presence can be useful, providing the information source is reliable. Other signs can include the pungent, unique smell that is present with heavy mouse infestations and to a lesser extent, where rats are involved. This is particularly noticeable on initial entry from the fresh outdoor air. In bulk storage areas for cereals there may also be evidence of rat-tail marks on the surface of the grain.

Traps

Live or spring traps may be used to assess changes in rodent populations if they are deployed in an effective and systematic way. Absolute rodent counts depend on the number, type and location of traps and a minimum of 20 well-placed spring traps per house, baited with an attractive allergen-free bait, is recommended to monitor progress in mouse control. The aim should be to get down to a level where less than one mouse per house per month (ideally none) is being caught.

Hygiene and proofing

On all premises where poultry are kept it is essential to maintain a continuous programme of hygiene and proofing to prevent the establishment of rodent infestations. **It is unacceptable to repeatedly make remedial applications of rodenticides on premises where insufficient attention is paid to preventing the ingress of rodents and to the correction of conditions that promote the build-up of rodent populations.**

Hygiene

Two main areas require special attention.

Feedstuffs

Shortcomings in the storage and handling of feed, particularly where spillages occur and can remain, can be a significant factor in providing attraction for rodents. This can then reduce the uptake and acceptability of rodenticide baits. Both rats and mice unavoidably have unrestricted access to feed present in slave hoppers, feeding troughs and pan feeders, especially at night. Spilled feed should not be disposed of into litter or manure.

On-farm observations suggest that in some cases acidification of poultry feed may make it less attractive to mice and this can enhance bait uptake.

The following are areas in which feed may readily become available to rodents and require special attention:

- Bulk hoppers, delivery pipes and slave hoppers outside the poultry houses, where spillages, incomplete covering or leaks will attract rodents moving into or around the unit.
- Indoor stores where open hoppers or spillages may attract rats and mice.
- Milling areas and mobile feed mixers.
- Faults in conveyors and other sections of distribution systems which may encourage a build-up of feed spillages.
- Presence of spillages, often after sweeping or blowing of the house, in areas beneath slats that are frequented by rodents.
- Excessive dust accumulations, often comprising a high proportion of feed particles.
- Broken egg material beneath egg belts and conveyors, or floor eggs remaining in litter.

Harbourage

Within units and building structures the availability of a wide range of materials will provide habitat for rodents, particularly mice.

The following will encourage the presence of rodents:

- Build-up of rubbish within units.
- The long-term storage of materials such as wood shavings, straw bales and egg trays in areas accessible to rodents.
- Stores containing equipment and spare parts.
- Poultry droppings and litter beneath slatted areas.
- Manure belt channels to the exterior or between houses.

Outdoors, rats will be attracted by:

- Rubbish and other materials in the vicinity of units.
- Natural vegetation cover.
- Ditches, hedges and banks, especially when poorly maintained.
- Rubbish dumps, bins for dead birds or waste eggs, and incinerator sites.
- Manure stores or woodchip stores.
- Drainage systems, manure belts and elevators or gantries that may provide a link between buildings.
- Accumulated egg material which has spilled from conveyor systems.
- Nearby farming or waste processing activities.

Proofing

The aim is to keep rodents out of vulnerable poultry farm buildings. These objectives need to be realistic and practical and take account of the physical capabilities of rats and mice.

Buildings offering an attractive environment and a source of food are most vulnerable to rats during autumn and winter when they are likely to exploit weaknesses or faults in the structures or associated areas.

Mice are less responsive to seasonal changes, mainly because they most commonly live within the fabric of buildings. However, factors that have a drastic impact on their environment, such as depopulation and cleaning, will influence the movement and distribution of mouse infestations. Their small size means that they can be easily introduced into units via the delivery and movement of materials such as feedstuffs, bedding/enrichment materials, litter or any other bulk items that can provide a temporary refuge.

Effective proofing of buildings or other structures against mouse entry is often extremely difficult due to their ability to get through very small gaps, but efforts to limit entry will have some beneficial effect. For example, mortar, lime and wire mesh can be laid at main doors to houses and drains to act as a deterrent and overhang baffles can be placed to prevent rodents accessing via ventilation systems or entry points for conveyors and other services.

Outdoor considerations

In free-range units, most problems relate to the interior of houses, but rats may burrow in from the outside and gain access to houses through gaps in the building structure. Where rat infestations exist, there should be well-maintained baiting points around the perimeter of the houses and burrows should be baited and covered to prevent access by non-target animals.

In some cases, there is a proven source of rodents that are coming in from neighbouring woodland or adjacent premises. In such cases it may be necessary to bait strategically in these areas or at the borders of the property, so long as the products used are authorised for use in open areas.

It is always beneficial to undertake joint action with neighbours. Special care should be taken when using baits outdoors to avoid as far as possible non-target wildlife or other animal species being exposed to bait. It is useful to note, however, that any bait that is accessible to rats and mice will also be available to non-target small mammals. It is the exposure of these species that leads to the contamination of many wildlife species.

Areas around the perimeter of buildings should be kept clear of vegetation and materials and a wide surrounding area of stones or gravel will help prevent burrowing close to houses. This will help to discourage rodents establishing on the site and assist with monitoring for signs of infestation. The main entry points into houses are vents, poorly fitting doors or other access routes into units as well as gaps left around manure conveyors or egg belts, electrical cabling or other services and pop holes. Drainage pipes, badly-fitting or damaged covers and grilles can also be exploited by rats.

Damage to the exterior of buildings such as cladding or block-work may cause further problems and weaknesses in building foundations may make them vulnerable to the burrowing activities of rodents.

Remedial action

Routine inspections to identify faults or damage should be implemented and timely repairs made which may conveniently be incorporated in the work schedule at the cleaning and maintenance phase of the cycle. In most situations it is best to control the rodent infestation before carrying out any proofing work. If this is not done it may result in problems in other sections of the unit. Although there may be some additional cost, the improvements will benefit the rodent control and prevention programme.

Metal baffles around services such as cables and pipes and kick plates on the lower edges of doors will prevent them being gnawed by rodents. Door access that is only required during the removal of litter/manure can be temporarily proofed by adding a concrete fillet or wire mesh to the vulnerable ground level sections.

Depending on the circumstances, drainage pipes or gullies should be proofed by fitting grilles, flaps, crushed wire mesh or other suitable materials.

Farm staff and outside contractors should be made aware of the importance of avoiding the creation of rodent access routes and harbourages when undertaking building works, modifying existing structures and when making changes to the management of the unit. All hollow block walls should be topped with concrete.

In the course of structural work, it may be appropriate to incorporate closable access points to allow checks to be made for rodent activity and permit the placement of rodenticide bait stations.

Control strategies and techniques

Initial Considerations

Building design

Rodent control should be considered when the poultry unit is built. Structures are often built which are ideal for rodents, having hollow walls, continuous supplies of food and water and with areas that are impossible to inspect properly. This leads to over-reliance on rodenticides to deal with rodent infestations that develop. Many potential problems can be avoided when buildings are designed with the future needs of rodent control in mind.

Risks to the environment

All first- and second-generation anticoagulant rodenticides fail the environmental risk assessment for permitted use outdoors, but Government recognises that this may be necessary to control rodents and to mitigate the threats to human and animal health they are known to present.

There are two main areas of evidence about anticoagulant rodenticides and their potential to harm wildlife.

1. Chemical analysis of the remains of some individual wild animals suggests that they may have died as a result of the irresponsible, incorrect or occasionally from the approved use of rodenticides. This is monitored and reported through a variety of schemes, one of which is the Wildlife Incident Investigation Scheme (https://www.hse.gov.uk/pesticides/reducing-environmental-impact/wildlife/wildlife-incident-investigation-scheme.htm).
2. Many species of wildlife carry residues of some of the commonly-used anticoagulant rodenticides in their bodies. Research has shown that these residues occur in a high proportion of individuals of some wildlife species, such as barn owls, red kites, buzzards, kestrels, foxes and other mammals. A proportion of individuals have residues above the level considered to have the potential to cause mortality. It is not known whether low-level or sub-lethal residues have any adverse effects, either on the individual animals that carry them or on wildlife populations. Because of the widespread nature of contamination of wildlife, those who use rodenticides should do so in ways that seek to reduce to a minimum any exposure of wildlife and other non-target animals.

The term ‘risk hierarchy’ has recently been applied to the use of rodenticides. The concept is that those intending to use any rodent control method, or combination of methods, should first consider their risks. These include risks to non-target wildlife, domesticated animals, and the environment, as well as human exposure.

Risks will differ between the situations in which control is to be conducted and, of course, the degree and type of risk presented by the various methods will also differ. The use of the risk hierarchy requires that the least severe method/methods (i.e. having the least risk) should be used, provided there is a reasonable expectation that the resultant operation will achieve the results required.

Generally those methods that do not employ a rodenticide, such as improved site hygiene and the proofing of buildings, are likely to present less risk than those that require a rodenticide. Conducting an environmental risk assessment (section 7) before the application of rodent control measures will assist appropriate consideration of the risk hierarchy.

Treatment options

Rodent eradication and prevention of infestations should be included as a major part of the unit and flock management and, if the strategy is to be successful, it must be carefully planned and have adequate resources committed to it.

Effective control can be achieved by taking one of the following options listed below:

1. Obtain the services of a commercial pest control company, preferably one holding membership of either the British Pest Control Association or the National Pest Technicians Association. The main consideration is the ability to agree a contract that will meet the needs of the enterprise and the demands of current and future rodent problems.
2. An alternative is for farm staff to carry out the control programme. If implemented correctly, a rapid and biosecure rodent detection and control response can be achieved. Those involved must, as required by the legislation, receive adequate training and instruction or be part of an industry assurance scheme and be competent in the use of biocides. Product label instructions and directions for use should be read, understood and followed. It is therefore essential that individuals undertaking the work are provided with the appropriate equipment and materials and allowed the time necessary to deal with problems that arise and carry out the other activities that form part of a control programme.
3. It may be appropriate to use a combination of these options with an expert advisor experienced in dealing with rodent problems, working in conjunction with farm personnel who undertake the day-to-day work.

With the use of a specialist contractor, there remains a need:

- For unit management and staff to understand rodent biology and behaviour.
- To make regular inspections.
- Liaise with contractors to obtain accurate details of and be familiar with control techniques used.

In considering the available options and regardless of the approach adopted, it is essential that sufficient time and resources are allocated to rodent control. This includes the assessment and monitoring of infestations, carrying out control measures using sufficient fresh bait and baiting points, and checking on the progress and success of operations.

The appropriate techniques for controlling most rodent infestations involve the use of rodenticides presented in edible bait formulations. Such materials have to be approved under the Great Britain Biocidal Products Regulation (GB BPR) and must be used according to the approval conditions and label instructions. The selection of products needs to take account of:

- Active ingredient involved.
- Bait palatability.
- Type of bait presentation.

- Differences between rats and mice with regard to susceptibility to the compound involved, behaviour and other relevant variations between the species.
- The possible presence of anticoagulant resistance in the rodent infestation to be treated.
- The ‘Risk Hierarchy’ in terms of the relative risks to human health, non-target animals and the environment of the different methods and chemicals used. It is best to employ the method, or group of methods, that are likely to be fully effective but which are the least severe in terms of the risk hierarchy.

Rodenticide options

Most of the products currently available for use against rats and mice are anticoagulant-based. These compounds interfere with the metabolism of vitamin K, which is involved with the production of blood clotting factors. If these factors are absent or below critical concentrations, the blood fails to clot and haemorrhaging occurs.

Most commonly used products require the rodent to take several feeds and death is usually delayed for several days. However, resistance to these products is widespread in mice and is increasing in rats. There are some ‘single-feed’ anticoagulant products that are more toxic which can be used with care in and around buildings (also described on labels as ‘outdoors – around buildings) with a persistent rodent problem, but not widely in the general environment in open areas and waste dumps.

It is important that adequate fresh bait used at enough baiting points is present throughout the treatment period. In houses that have Salmonella and rodent problems, it is recommended that there should be a baiting point every three to four metres across the whole house, where this is possible to do safely and is permitted by product labels, not just around the walls. This means anchoring baiting points if they are liable to become dislodged. Bait points should also be carefully placed on any ledges, provided care is taken to avoid bait falling from bait stations to places where poultry may have access, and in any gaps used by rodents. It is particularly beneficial to create ports in wall and roof spaces or mini-pits to place and regularly service bait stations in inaccessible areas in which rodents are nesting or moving.

First-generation anticoagulants

These include rodenticides based on warfarin and coumatetralyl.

These compounds are still effective against susceptible rat populations that are not genetically resistant to such active ingredients. In practice, this means that some rat infestations in this country can be dealt with using products containing these rodenticides. However, because house mice are naturally less susceptible to them, their use against this species is not recommended.

Second-generation anticoagulants

These include difenacoum, bromadiolone, brodifacoum, difethialone and flocoumafen.

All five compounds are more potent than the first-generation group and are effective against any rat populations that are resistant ONLY to first-generation anticoagulants. However, in some parts of the country there are now rat infestations that are resistant also to bromadiolone and difenacoum. In this case, baits containing brodifacoum, difethialone and flocoumafen should be used against them. Resistance to the first-generation anticoagulants, and to the second-generation substances bromadiolone and difenacoum, is now so widespread in-house mice that, among the anticoagulant substances, only brodifacoum, difethialone and flocoumafen should be used against them.

Difenacoum and bromadiolone formulations may be used indoors, outdoors around buildings and outdoors in open areas and waste dumps (product labels will show which areas are specifically authorised for the products being used). These active substances can be used in permanent baiting programmes, where the approved conditions for this practice are met (see product labels). Baits containing brodifacoum, flocoumafen and difethialone can only be applied indoors and outdoors around buildings (again, product labels will indicate where the individual product can be used). This is alabel requirement due to the greater potential hazard that such compounds present to non-target animals. These three substances cannot be used in permanent baiting programmes.

Other compounds

Some non-anticoagulant rodenticide products are authorised for use and all of them have the advantage of a different mode of action to that of the anticoagulants. This makes them useful against all anticoagulant-resistant rodent infestations. These substances can only be used by competent professionals, including farm staff with appropriate training, and their different authorised uses are as follows:

Cholecalciferol can be used against rats and house mice; areas of use can differ between products so always read the label before application. The substance can also be used in permanent baiting programmes, where these are necessary and permitted. Baiting procedures for cholecalciferol are different from those generally used when anticoagulants are applied and therefore special care should be taken to read the product label and to follow the guidance given.

Alphachloralose is a non-recovery anaesthetic which has a more rapid action in cool conditions, such as when buildings have been depopulated. This substance is authorised for use only against house mice indoors.

Carbon dioxide is used as a killing method when discharged into a proprietary trapping device. This is currently used only by a single, large commercial pest management company against house mice.

Rodenticide formulations and presentations

Whichever formulation or means of presentation is used, great care must be exercised where there is the possibility of pets, feedstuffs, livestock and products such as eggs becoming contaminated.

Edible rodenticide baits are produced in various formulations including:

- Meal or cut cereals.
- Whole cereal grains.
- Pellets.
- Seeds.
- Peanut oil and pasta-based paste sachets.
- Wax-bound cereal blocks.
- Lards and gels.

Rodenticides may also be presented as water-based bait and as contact products, including foams and gels.

Contact rodenticides rely on the rodent picking up the toxic material on its body and then ingesting small amounts during grooming activity. Accordingly, this makes them unsuitable for application where feedstuffs, or products such as eggs could be exposed to such materials with the risk of contamination. Users must refer to the product label for usage instructions for contact gel or foam rodenticides.

The use of liquid baits in poultry units is likely to have practical limitations but may be a useful option or supplementary measure in dry conditions where rodents do not have ready access to water.

Fumigant use

Aluminium phosphide pellet formulations (which release phosphine gas when they contact soil moisture) are authorised for the control of Norway rats by burrow fumigation. All aspects of the purchase, transport, storage, use and disposal of formulations based on aluminium phosphide are controlled by a stewardship programme, the Register of Accredited Metallic Phosphides Standards (RAMPS), which should be consulted when considering the use of these products (see: https://basis-reg.co.uk/scheme-ramps).

Hydrogen cyanide is also authorised for use in the UK against Norway rats by application as a fumigant inside empty structures by professional technicians. Methods of application and risk mitigation measures to protect those making the application, bystanders, non-target animals and the environment are highly specialised and technically challenging. This control measure can therefore be applied only by companies that have specially trained and certificated technicians and appropriate equipment.

Bait formulation choice

A number of conditions will influence the choice of which formulation(s) to use and these include:

- Rodent species.
- Location (indoors or outdoors).
- Non-target species or other hazards.
- Adverse site conditions (including damp or dusty environments).
- Cost of materials.

Palatability is probably the most important issue for successful baiting and rodents will be reluctant to take bait if it is less palatable than the poultry feed that they have access to. Products must therefore be assessed for palatability/uptake and kept fresh and free from dust. It is also very important to place bait close to rodent nesting areas and run routes so they are more likely to travel to the nearby bait than to more distant feed or broken egg material.

No hard and fast rules can be provided about the choice of formulation and much will depend on the nature and circumstances of the problem including what previous control actions have been taken. There will often be a number of options that may be suitable, or combinations of approaches may be most effective.

Baiting techniques

Having carried out a survey of all areas of the site and buildings, and decided upon a suitable rodenticide, it will then be necessary to establish sufficient baiting points at appropriate locations that will cover all areas of rodent activity. Product labels will provide instruction about how baits may be safely and effectively applied but this may be affected by factors including:

- Hazards to poultry or other non-target species.
- Risks of contaminating feed, manure or sensitive areas.
- Adverse conditions (e.g. wet floor areas during cleaning, damp external areas, areas contaminated by faeces or dust).
- Risk that baits will be regularly disturbed or eliminated.

Commercially available tamper-resistant bait boxes should normally be used to secure baits from non-target animals. However, where safe to do so, and where a product is shown on the label to be authorised for use in ‘covered and protected bait points’, bait points may be secured using materials available at the site, as long as these bait points provide the same level of protection for non-target species and humans as proprietary tamper-resistant bait stations.

Outdoors, some products can be laid directly into rodent burrows and it is only with this type of use that recovery of uneaten baits is not required. Burrow baiting is also a

specialist application that is only permissible with baits that show this use on the label. A range of risk mitigation measures must be applied when it is used, including only placing bait deep into burrows, securing block or sachet baits into burrows on a wire, marking and covering the treated burrow and frequent checks to remove bait that is sometimes dragged out of the burrow (see: https://www.thinkwildlife.org/downloads/).

Where possible, tamper-resistant bait boxes should be secured to the substrate and, within them, formulations presented as either wax blocks or in sachets should be fixed in position. Contamination by dust or moisture should be avoided. Baits need to be assessed for palatability/uptake and kept fresh, so should never be placed in pits, or other areas inaccessible to people such as roof and wall voids if there is no means to retrieve them and where the recovery of uneaten baits at the end of the treatment is not feasible. Controlled baiting stations must therefore be created within such spaces if they are to be baited. Tamper-resistant bait boxes must be appropriately labelled according to the instructions to be found on product labels.

Within poultry units there are a number of key areas that are likely to require particular attention including:

- Feed and egg storage areas, including areas around open slave hoppers within houses and service areas.
- Material and equipment stores.
- Droppings pits and other areas protected from birds, e.g. beneath nest boxes and manure belts.
- Voids in walls, ceilings or at ground level, including manure belt channels.
- Routes used by rodents to move around the house, including ledges, beams, partitions, tops of cages, nest boxes, bases of walls, conduits, false floors and ceilings etc.
- Accumulations of materials and vegetation around the perimeter of buildings.
- Adjacent hedgerows and ditches.

But, when bait is deployed in any of these areas, it is always necessary to adopt the mitigation measures required by the product label to protect baits from non-target animals and to ensure that any uneaten bait can be recovered.

Instructions on the quantities of bait to be laid, the number and frequency of bait points will be specified on the product label. However, as a rule, a larger number of small points are required for mice, whilst for rats fewer points may be needed but they must be suitably placed in or close to nesting areas and will contain more bait. Large rodent populations require intensive and frequent treatments to eliminate breeding animals. Many anticoagulant rodenticides require rodents to feed daily on the bait for several days and so it is essential that bait points are regularly checked and topped up as necessary according to schedules set out on labels. In most cases, baiting points should not be allowed to run out of bait as this may reduce the effectiveness of the treatment and ‘recovered’ rodent populations may be more reluctant to take bait in future. If bait is allowed to run out (except in pulsed baiting), become unpalatable, or there are insufficient bait points, then

control is likely to be unsuccessful. For mice, regularly moving the location of bait points may help to maintain rodent interest.

Once effective control has been achieved, this intensive baiting may be replaced by an ongoing baiting strategy that involves reduced baiting focused largely on potential entry points into the house and high-risk storage or potential nesting areas. This permanent baiting is only permissible using baits containing cholecalciferol, bromadiolone and difenacoum that are labelled for such use.

Permanent baiting is strictly limited to sites with a high potential for reinvasion when other methods of control have proven insufficient. The permanent baiting strategy should be periodically reviewed in the context of integrated pest management (IPM) and the assessment of the risk of re-infestation.

Sites under a permanent baiting regime should be inspected regularly in accordance with product label directions. The period between visits should be determined by the technician in charge but will not be longer than every four weeks when permanent baiting is conducted outdoors. If re-infestation occurs despite permanent baiting, professional advice should be sought, including the temporary use of more potent ‘single-feed’ baits, if required.

The increased toxicity of difethialone, brodifacoum and flocoumafen means that they can kill both rats and mice following only one feed on the bait, if enough bait is consumed. This will influence the baiting procedures but monitoring and topping up of points will still be necessary. Special care must be taken to remove baiting points from poultry houses, especially when used in manure pits, before mucking out.

Secondary poisoning cases for wildlife and pets around poultry units seem to be especially linked to poultry units which are being cleaned out, encouraging rodents inside buildings to move out to the external environment in high numbers. Secondary poisoning appears to occur when large amounts of bait are used at this time and rodents leaving the buildings are carrying high levels of rodenticide. Under these circumstances substances such as alphachloralose and cholecalciferol should be considered as these are unlikely to result in significant residues in the bodies of target rodents, and hence to secondary poisoning.

Treatment strategies

The aim in poultry units should be to prevent infestations of breeding rodents becoming established by combining a baiting programme with regular monitoring and preventative measures.

The control strategy will vary according to whether action is being taken whilst the birds are occupying the building or if measures are aimed at the end of the cycle, when depopulation, cleaning and disinfection is carried out.

Bait will become spoiled or contaminated if baiting points are left in place during washing or the application of chemicals, but they should be replaced as soon as possible after

completion of these stages if there is an active infestation. Baiting within wall and roof spaces can continue during washing and is particularly valuable at this time provided the baits are protected from non-target animals and uneaten bait can be recovered.

Successful control relies on the ability to bait all possible areas of rodent activity and so should include movement and living areas such as beams, ledges, cage structures, banks of nest boxes and hollow or insulated walls or roofs. Closable entry ports cut in walls and ceilings can allow the placement of baiting points and recovery of bait, particularly in paste sachets, wax block or gel formats, in locations that are otherwise inaccessible.

Regarding manure pits or areas beneath slats where droppings accumulate, it is recommended that bait points are established when the house is restocked. These should be protected from subsequent contamination using bait boxes to deflect waste materials and dust.

Access ports for servicing the bait points in mini-pits should also be set up. They need to be sited around wall or structure perimeters or at other locations where rodent movement or presence is likely or has been detected. They should be checked regularly according to the label requirements. In mini-pits, plastic pipes containing baiting points can be set up which run from the side of the pit towards the interior, or from above, by wiring baiting points within service tubes that can be filled from above to pit supports. Another approach would be to place the bait in a lightweight paper or plastic bag which can then be put into a bait box or other protected area. If baiting is undertaken in the pit, it is important that any uneaten bait and containers are removed when the pit is emptied and such material disposed of safely.

If rodent infestations are identified in areas occupied by the birds and treatment is required, specific measures will be necessary to prevent poultry from gaining access to the rodenticide baits. These will include the use of secure bait containers on beams and areas that are inaccessible to the birds and constructing baffles or tunnels that will allow entry by rodents but deny access to poultry. Baits should be secured into bait boxes to prevent spillage. Where infestations occur in areas beneath slatted floors where there is no access, these can be difficult to treat. It may be possible to suspend wax blocks on wires so that they are within reach of rodents or to set up baiting access as mentioned previously. Where mice are present in barn or free-range houses they often occupy spaces in the insulation layers, these areas need to be identified and bait introduced into the relevant wall or ceiling spaces, provided that uneaten bait can be recovered.

Control at depopulation will depend on whether routine treatments need to be continued or if there has been a build-up of rodents that necessitates a major eradication exercise, e.g. in Salmonella-positive houses. If it is necessary to prioritise action due to the number of sites involved or other influencing factors, then control measures should be concentrated in houses where Salmonella infection has been confirmed. This will reduce the chance of infected rodents being displaced from a Salmonella-positive house and moving into a previously uninfected location.

If continued routine measures are indicated, such efforts should be maintained during the cleaning and site preparation stages and consideration given to increasing the number of bait points in livestock areas and droppings pits prior to restocking. It is important to run down feed supplies and remove any residual feed and spillages immediately once birds are removed to increase the uptake of bait by rodents.

Where rats have been a problem or are likely to be present, baiting around the outside of buildings should continue in order to reduce the chances of them moving as a result of the disturbance caused by the routine end of cycle work and then subsequently becoming re-established.

Where mouse or rat populations have built up, it will be necessary to carry out intensive baiting of the area to eliminate the infestation prior to restocking. This will have to be fitted in with cleaning operations and operators should be aware that baits may become unpalatable due to contamination by water, disinfectant, fumigants and other cleaning materials. It is therefore desirable to allow some extra time for baiting before mucking out where rodents have built up during the housing period, ensuring that all feed material has been removed. Baits should be replenished according to label requirements and must be maintained during the period when the house is empty and clean, awaiting a new batch of birds.

Pit or manure belt entry points and unit doors should be kept closed when not attended to prevent entry of other animals and exposure of non-target animals to rodent baits. It is essential that a competent and responsible person oversees this operation as there is a risk that valuable baiting opportunities may be missed and, if Salmonella-infected rodents remain on site after cleaning and disinfection, it is highly probable that the next flocks placed in previously-positive houses will become infected, regardless of the vaccination status or standard of cleaning and disinfection.

Baiting can also help when there is a known risk of rodents coming onto the site from neighbouring locations. For mice, bait will usually be laid indoors in places where there is a high risk of infestation and at potential entry points, but for rats it may be appropriate to locate well-protected bait stations in hedgerows, ditches or other habitat features outside the unit which new rats are likely to encounter when investigating the site. This technique, if conducted at a distance from the buildings, is called application in ‘open areas’. This is permissible only with baits that are labelled with this phrase and is normally used to greatest effect in the autumn and winter, when such movement is most likely.

Wherever rodenticides are used, it is a requirement that any discovered rodent carcases are disposed of safely. Unused or discarded bait should be dealt with in a similar manner. Consult the product label for instructions on disposal. In most cases the advice about disposal on the product label is as follows:

Dispose of dead rodents in accordance with local requirements. Poisoned rodents may be disposed of by the waste producer at an incinerator or landfill permitted to accept that type of waste or collected by a registered waste carrier and taken for disposal at a suitably permitted site. For further information on disposal contact the Environment Agency

(http://www.environment-agency.gov.uk), Scottish Environment Protection Agency (SEPA) (http://www.sepa.org.uk), Natural Resources Wales or DAERA.

Other control techniques

The use of methods other than those based on rodenticides has limitations in the control of significant rodent infestations that are already present in poultry units and these are unlikely to form a major part of an overall strategy. However, there are occasions, such as when toxic compounds are not permitted to be used, or rodents will not take baits, where operators may have to resort to other approaches despite their limitations.

Traps

These may be live-capture cage or other traps, or traps that operate by a spring mechanism that are designed to kill the rodents which are captured. It is usually necessary to use a large number of either type of trap but checking, re-siting and setting are time consuming and labour intensive.

Only spring traps approved under the Spring Traps Approval Order (or equivalent in Scotland, Wales and Northern Ireland) may be used, although break back traps commonly used against rats and mice are exempt from the requirement to be approved. It is illegal to use any spring traps on outdoor runs or in the open unless they are set in natural or artificial tunnels. Purpose made boxes designed to accept traps for both rats and mice are available.

Traps distributed throughout areas within houses where infestation is likely can be a useful monitoring aid particularly for mice. When used during turnaround periods they can help to identify residual or developing rodent populations.

All traps should be checked at least once a day and any rodents caught alive must be killed humanely.

Sticky, or glue, boards incorporating a substance usually described as rodent glue are sometimes used. These are placed on runs or other rodent movement areas and rely on the rat or mouse becoming entangled and unable to escape from the board. There are humane concerns regarding such use as sticky, or glue boards pose significant risks to animal welfare for both target and non-target species and should only be used by professional pest controllers as a last resort and in exceptional circumstances, when no other control option is suitable or other more humane options have failed. Rodent glue boards must be placed in such a manner that they do not present a risk to non-target species.

If a non-target animal is trapped, a freeing agent should be applied to the animal for removal. These boards should be checked at frequent intervals in order to minimise the rodents' time spent on traps and/or free non-target species and not more than 12 hours after they are set and then subsequently not less frequently than every 12 hours. Any

captured rodents should be humanely dispatched. Advice on the use of these devices is available from the Pest Management Alliance (https://www.pmalliance.org.uk/codes-of-best-practice/).

The success of trapping depends largely on the siting of traps and the intensity of trapping. Trapping alone would not be expected to remove more than a small proportion of a substantial rodent population. Therefore, any rodents caught in traps serve as an indication for review of the whole rodent control strategy.

In England, glue traps are to be banned under the Glue Traps (Offences) Act. Licences to use glue traps may be issued to professional pest controllers on an exceptional basis, to preserve public health or safety where there is no suitable alternative. Licence holders would then need to follow conditions set out in the licence to ensure the welfare of any rodents is upheld, such as regular monitoring of set traps. This means those found to have used a trap in England without a licence could face up to six months in prison and/or an unlimited fine. The ban will come into force in the next two years.

Cats and dogs

The presence of cats or dogs on a poultry farm may deter ingress of rodents onto premises that are free from them. However, these animals can play no significant part in a comprehensive rodent control plan. There are also biosecurity concerns because cats can carry a range of poultry diseases and should not be allowed access to occupied parts of poultry houses or feed or bedding stores. Dogs may also carry *Salmonella* and spread surface contamination. As a result, some assurance schemes ban the presence of cats and dogs inside poultry houses. There may be a role for terriers to kill rats during the mucking out process to prevent their wider dispersal on some types of farm, but this must be very carefully planned and managed. If bait has previously been used care should be taken to prevent dogs from gaining access to bait or from consuming rodents that are taken.

Ultrasonics

Claims are made that high frequency sound can be used to distract rodent populations and drive them away from problem areas. Several such devices are commercially available. Although the principle may appear attractive and offer benefits, its practical application has generally produced disappointing results and there is a lack of verifiable information from trials/studies in support of such use.

Human health and environmental risk

Safety considerations

The health and safety of the unit staff, other site visitors, pets, livestock and wildlife must be considered regarding:

a) Problems created directly by rodent infestations.

b) Risks associated with the use of rodenticides and control techniques.

Infestation problems

Where rodents are present, then the following basic disease precaution measures should be adopted:

- When working in infested areas or handling contaminated equipment suitable waterproof gloves and a dust mask should be worn.
- Cuts or grazes should be treated and covered with waterproof dressings.
- Hands or exposed skin should be thoroughly washed prior to eating, drinking or smoking and before leaving the site.
- Staff, and others working on the site, should be made aware of the potential risks of zoonotic disease (including leptospirosis, Hantavirus syndromes and salmonellosis) and the need to inform their doctor if there is the suspicion that illness has been contracted at work. Staff may be issued with contact cards which provide basic information on zoonoses.
- Staff, and others on site, should be warned about the hazards posed by rodent damage to electrical wiring systems.

Rodenticide use and control measures

Operators must be trained regarding the rodenticides that are used and be aware of the potential hazards that they may pose. The requirements for protective clothing and safe working practices must be understood before treatments are carried out.

Planning of control operations should include the action to be taken in the event of accidental poisoning. It is vital that those (General Practitioner or Veterinarian) treating such cases are informed immediately of the specific chemical involved and any relevant information on its mode of action provided by the product literature.

Records should be kept of the rodenticides being used and their distribution within the unit.

The protection of non-target species including wildlife, farm stock and domestic pets will need to take account of:

- The formulation and toxicity of the bait used.

- Where and how the bait points are to be located.
- Use of bait boxes and containers.
- Disposal of rodent carcases and unwanted bait.

Rodenticides and related equipment must be stored in a safe and secure location, away from other hazardous materials such as fuel and substances such as disinfectants which could taint bait formulations. The exclamation mark ‘Hazard Warning’ sign should be displayed in a prominent position on stores containing pesticides.

All containers used for storing or carrying bait must be properly labelled with the appropriate rodenticide information. Toxic materials should never be stored, even temporarily, in food or drink containers. A record should be kept of the type and quantity of rodenticides being stored along with the Material Safety Data Sheets (MSDS).

Label instructions and precautions must be read, understood and followed.

Risk assessments

The varied human safety and environmental considerations that are relevant to rodent pest infestations on poultry farms and their management may be addressed using risk assessments. Three different assessments may be relevant.

General risk assessment

Responsibility for the health and safety of employees at work falls on their employer. Working environments that are likely to harbour rodent infestations, or are known to harbour live infestations, or droppings/urine from previous infestations, present obvious risks to those who work in them because of the disease organisms that these animals can carry and transmit. To develop appropriate risk characterisation and to implement necessary risk mitigation measures, it may be necessary to carry out a risk assessment.

The Health and Safety Executive provides advice both to those who wish to conduct a general risk assessment (https://www.hse.gov.uk/pubns/indg163.htm) and for those wishing to reduce the risk to those working on farms including the risk of transmission of various zoonoses (https://www.hse.gov.uk/pubns/priced/hsg270.pdf).

COSHH Assessment

The rodenticide active substances mentioned in this document may be considered to be substances that are hazardous to human health. Therefore, when a decision is made to use one of them in a rodent control programme it may be necessary to conduct a Control of Substances Hazardous to Health (COSHH) Assessment. This is solely concerned with the health of those who make the applications and anyone who may accidentally come into contact with the bait. Once again the Health and Safety Executive provides assistance on deciding when a COSHH Assessment is required and how one should be carried out (https://www.hse.gov.uk/pubns/indg136.pdf).

Environmental Risk Assessment

As mentioned previously, many of the rodenticide active substances fail environmental risk assessments, although they are permitted for use by the UK regulatory authority because there are no sufficiently effective alternatives that offer substantially lower risk to the environment. Therefore, the use of these rodenticides poses obvious risks that should be assessed using an environmental risk assessment (ERA) procedure. An ERA isrequired when any rodenticides is used outdoors and there may be risks to wildlife. The Campaign for Responsible Rodenticide Use (CRRU) UK provides guidance on the use of ERAs and has published a working template to help practitioners to conduct them (https://www.thinkwildlife.org/downloads/).

Biosecurity

It is important to consider and introduce appropriate measures that will assist in preventing the introduction of disease to the farm and spread within units. There are several aspects related to rodent problems that should be considered.

Rodent droppings, particularly those deposited by rats, should be regularly swept up and removed from walkways. As a potential source of *Salmonella* infection they can be picked up on footwear and transferred between houses.

Contractors visiting the site must observe effective disease prevention procedures that should include appropriate footwear provided by the site, disposable overalls and gloves and the use of an approved disinfectant both on and off the premises. Wherever possible, keep vehicles and equipment outside of risk areas. If it is necessary for them to be taken onto the site, they should be cleaned and spray disinfected as required.

A risk assessment should be undertaken regarding the personnel involved to establish if they visit other farms for pest control purposes. The possibility of transmission of pathogens as a result of such activities needs to be considered.

If bait boxes, containers, traps or other control equipment need to be moved between houses, the possibility of transferring infection should be taken into account. If a decision is made that these items need to be cleaned the use of detergents and disinfectants that might impart taint, and therefore act as a deterrent to rodents, should be avoided, or washed off after use. Bait boxes and traps that are to be re-used in cleansed and disinfected houses should be treated to the same standard or replaced, particularly if *Salmonella* has been present on the site.

During cleansing operations, particular attention should be paid to urine pillars deposited by mice and grease marks established by both rats and mice. These are often difficult to remove and can act as a reservoir of *Salmonella* and other bacteria.

Annexes

Annex 1: Summary checklist

Key points

1. Prevent build-up of mice/rats during the production period of the flock – increased response at depopulation IS TOO LATE.

2. Where there is a rodent problem, especially where a flock is *Salmonella*-positive, rodent control action must be timely and very intensive.

3. Traps should be used to assess mouse populations and progress of control programs. Use a minimum of 20 traps in each house.

4. Initially, use several different approaches to control at the same time and then monitor and refine based on results.

5. Product label instructions and directions for use must be read, understood and followed.

6. Individual tastes of rodents within the unit may vary and proper selection and positioning of bait is crucial.

7. Ensure bait is protected from non-target species and will not cause contamination. If possible place bait throughout the house and not just around the house walls. Distribute baiting points approximately three to four metres apart. Remember to also place bait in wall and roof spaces.

8. Place baiting points in manure belt channels, mini-pits and in protected areas beneath automated nest boxes in barn and free-range housing.

9. Use a logical basis for choice of control techniques and bait types, taking consideration of the following:

- Lifecycle and habits of the rodents.
- Building design and structural condition.
- Palatability of bait and selection for ‘bait-averse’ rodents.
- In house action v. contractor use – timeliness and other issues.
- Legal restrictions on use of certain bait types.

10. Undertake regular monitoring of response to the control/baiting programme and immediately react to any detected increase in rodent numbers or activity levels and maintain or amend controls as necessary.

Rodenticide and bait formulation options

Mainly restricted to anticoagulant compounds, with a wider range of bait products and other formulations being available for specific situations (see rodenticide options section above):

- First generation (warfarin and coumatetralyl) – resistance considerations
- Difenacoum and bromadiolone – suitable for indoor use and locations that are outdoors around buildings and in open areas, may be used in permanent baiting. Resistance considerations for house mouse and some rat infestations.
- Brodifacoum, difethialone and flocoumafen – suitable for indoor use and locations that are outdoors around buildings, should not be used in open areas or for permanent baiting. No significant resistance considerations for either house mouse or rat infestations.
- Cholecalciferol - areas of use can differ between products so always read the label before application. May be used in permanent baiting programmes. No significant resistance considerations for either house mouse or rat infestations.

Checklist to minimise pest populations at depopulation:

- Ensure adequate downtime.
- Careful inspection for rodent activity during removal of equipment and litter/manure.
- High standard of cleaning.
- Plan to maximise baiting during the empty period.
- Prevent re-infestation from adjacent houses/areas.

Annex 2. Auditing rodent populations

This Annex provides a simple check on rodent populations, potential rodent harbourage, and existing rodent control and monitoring measures in stocked poultry houses. It is intended to assist in assessing the actual or potential problems regarding rodents and highlight the areas that should be improved. In order to obtain as objective an assessment as possible, it should be completed by an external auditor or pest specialist. The audit should be carried out on all areas where rodents might be a problem, including poultry houses, anterooms, service and feed, bedding, solid fuel (e.g. firewood, coal), tools and equipment and manure storage areas.

- Any answer in a grey filled tick box suggests the need for corrective action and provides an indication that specialist advice may be required.
- Any answers in a dotted tick box suggest a cause for concern. In cases where Salmonella is present in the flock prompt corrective action is essential.

Auditing potential for rodent harbourage

(to be completed for each poultry house)

Concrete house surroundings

■ No

▒ Partly

☐ Totally

Puddles, vegetation and/or residual feed/manure around the house

■ Abundant

▒ Some

☐ Absent

Feed spillage in house (including beneath slats)

■ Abundant

▒ Some

☐ No

Manure storage

☒ Yes, emptied once a year or less often

☐ Yes, emptied 2-3 times a year

☐ No

Included in rodent monitoring and baiting programme?

■ No

☐ Yes

Association of a poultry house with other poultry houses

☒ Communication through open corridor/manure or egg conveyors beneath slats or other relevant routes.

☐ Other contiguous house/s

☐ No direct communication

☐ Single house

Air inlets/outlets

■ Not proofed

☐ Proofed or not accessible

Sealing of doors/other entry ports

■ Very poor

☒ Some proofing or not easily accessible

☐ Good seal

State of repair

■ Poor

☒ Average

☐ Excellent

Potential for entry of rodents

■ High (i.e. well built/ maintained)

▒ Moderate

☐ High (i.e. can easily access the building in its present state)

Potential for harbourage of rodents

■ High

▒ Average

☐ High (i.e. could easily act as harbourage in its present state)

Auditing rodent control/monitoring programme

Type of control programme

■ No control programme

▒ Control programme exists, but unsystematic, no records kept

☐ Systematic and written†

Monitoring programme

■ No monitoring programme

▒ Inadequate monitoring

☐ Systematic and written

Auditing rodent populations and baiting

(to be completed for each house and feed store)

Signs of mice inside the house (including beneath slats)[3]

■ Abundant

▒ Some/few

☐ None

Signs of rats inside the house (including beneath slats)[4]

■ Abundant

■ Some/few

☐ None

Signs of rats outside the house

■ Abundant

▒ Some/few

☐ None

Level of coverage of baiting inside house [å]

■ Poor

▒ Average

☐ Very good

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[3] Includes live/dead rodents' faeces, urine pillars, typical smell, grease marks, uptake of bait, structural damage;

[4] Includes live/dead rats, burrows, structural damage, uptake of bait.

†Includes plan of baiting/trapping points, type of bait used, dates of baiting replenishment and number of rodents trapped

Quality of the baiting inside house [å]

■ Poor

▒ Average

□ Very good

Level of coverage of baiting outside house [å]

■ Poor

▒ Average

□ Very good

Quality of the baiting outside house [å]

■ Poor

▒ Average

□ Very good

[å] evaluated according to presence or risk of infestation