

## Guidelines for the Housing of Rabbits in Scientific Institutions

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## Key Recommendations

- 1.5.1 *To meet the requirements of the Code of Practice (ie to provide accommodation that meets the species-specific needs of rabbits), housing should be provided which allows rabbits the opportunity for social interaction, the opportunity to carry out normal behaviours such as hopping and rearing upwards (freedom of movement) and the opportunity to rest and withdraw from each other.*
- 1.5.2 *The Code of Practice recognises that there may be circumstances where the requirements of experimental procedures will preclude meeting some species-specific needs (Clause 4.4.22 (ii)). Housing in these situations should still meet the physical and psychological needs of rabbits as closely as possible.*
- 2.2.1 *Rabbits should be housed in groups in pens.*
- 2.2.2 *Rabbits that cannot be housed in groups (eg intact males or for experimental reasons) should be housed in pens with olfactory, visual and, if possible, physical contact with adjacent rabbits.*
- 2.2.3 *Rabbits should only be housed in cages with the express permission of the Animal Ethics Committee of the institution on the basis of compelling evidence for the need to use such housing. In such cases, cages should be enriched by methods as described in this document (such as pair housing in double cages). Lack of space or facilities for pens should not be considered sufficient justification for the use of such cages.*
- 2.2.4 *Rabbits should not be housed singly in conventional (unenriched) cages except in exceptional circumstances and with the express permission of the Animal Ethics Committee of the institution on the basis of compelling evidence for the need to use such housing. Such circumstances may, for example, relate to research into the effects of such caging on rabbits. Lack of space or facilities for pens should not be considered sufficient justification for the use of conventional cages.*

## 1. General

### 1.1 Introduction

(i) These guidelines are intended for use by people involved in the housing and care of rabbits in scientific institutions. The guidelines are not intended to be a complete manual on rabbit care and management but rather to provide some key guiding principles on best practice standards in rabbit housing. The guidelines will be revised from time to time to take account of advances in the understanding of rabbit physiology and behaviour, technological advances, and changes in community attitudes and expectations about the welfare of animals.

(ii) The guidelines are based on principles regarding the care and management of rabbits taken from scientific literature. These principles are detailed throughout the document, as are recommendations for the care and management of rabbits which are derived from these principles. In some areas, conclusions to be drawn from the available literature are not entirely clear, and in such areas recommendations are extrapolated from information available and practices in rabbit care and management current at the time of writing.

(iii) The principles outlined in the document address requirements of the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes* (as outlined below in Section 1.5). The requirements of the Code of Practice include that animals held for scientific purposes should have their species-specific behavioural and physical needs met, whilst at the same time ensuring that the animals can adequately be monitored and are protected from disease and taking into account the requirements of the research for which the animals are being used.

## **1.2 Responsibilities of Institutions**

### **Recommendations**

*1.2.1 Institutions using rabbits for scientific purposes are responsible for responding effectively to recommendations of the institution's Animal Ethics Committee to ensure that facilities for the housing and care of rabbits are appropriate to the maintenance of well-being and health of the rabbits.*

## **1.3 Responsibilities of Chief Investigators / Teachers**

### **Recommendations**

*1.3.1 The chief investigator/teacher (person in charge of a research/teaching project) has direct and ultimate responsibility for all matters related to the welfare of rabbits under his or her control, which includes their housing and care. (As per the principle contained in Clause 3.1.1 of the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes)*

*1.3.2 The chief investigator/teacher should ensure that the extent of personnel / staff supervision is compatible with the level of competence of each person and the responsibilities they are given in relation to rabbit care and management. (As per the principle contained in Clause 3.1.3 of the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes)*

## **1.4 The Australian Code of Practice for the Care and Use of Animals for Scientific Purposes**

### **Principles**

(i) The Australian Code of Practice for the Care and Use of Animals for Scientific Purposes states:

4.4.22 Animal Accommodation should be designed and managed to meet species-specific needs. Pens, cages and containers should be constructed and maintained to ensure the comfort and well-being of animals. The following factors should be taken into account:

- (i) Species-specific behavioural requirements, including the availability and design of space to enable free movement and activity, sleeping, privacy and contact with others of the same species;
- (ii) provision of single housing for animals where it is appropriate for the species and if necessary for the purpose of the study, eg during recovery from surgery or collection of samples;
- (iii) species-specific environmental requirements such as lighting, temperature, air quality, appropriate day/night cycles and protection from excessive noise and vibrations;
- (iv) the need to provide ready access to food and water;
- (v) the need to clean the pen, cage or container;
- (vi) protection from spread of pests and disease;
- (vii) requirements of the study; and
- (viii) the need to observe animals readily.

4.4.23 Pens, cages and containers must:

- (i) be constructed of durable, impervious materials;
- (ii) be kept clean;
- (iii) be maintained in good repair;
- (iv) be escape-proof;
- (v) protect the animals from climatic extremes;
- (vi) not cause injury to animals;
- (vii) be large enough to ensure the animal's well-being; and
- (viii) be compatible with the behavioural needs of the species.

4.4.24 The population density of animals within cages, pens or containers and the placement of these in rooms must be such that acceptable social and environmental conditions for the species can be maintained. Where it is necessary to individually house animals of a species that is normally kept in a social group, the conditions should be managed so as to minimise the impact of social isolation. Animals should be housed in these circumstances for the minimum time necessary.

4.4.25 Bedding and litter must be provided if appropriate for the species, and should be comfortable, absorbent, safe, non-toxic, able to be sterilised if needed, and suitable for the particular scientific or educational aims. Pregnant animals must be provided with nesting materials where appropriate.

4.4.26 The Animal Ethics Committee and relevant investigators or teachers should be informed in advance of planned changes to these conditions, since these may affect the welfare of animals and the results of the scientific and teaching activities.

## 1.5 Aspects of Rabbit Behaviour Relevant to Housing

### Principles

(i) All laboratory rabbits derive from the European rabbit (*Oryctolagus cuniculus*). The behaviour of laboratory rabbits is very similar to that of wild rabbits.<sup>6, 31, 33, 34</sup>

(ii) Wild rabbits are naturally gregarious and live in breeding groups. Within each group there is a linear dominance hierarchy for each sex. Social rank within each group is established by physical fighting or confrontations (eg chasing) between individuals.<sup>31, 34, 38</sup>

(iii) Studies have shown that, given the opportunity, laboratory rabbits prefer to be together, spending about 79% of their time in each other's company.<sup>36, 10, 16, 24</sup> Amicable behaviours when together include lying near each other, grooming each other and nuzzling.<sup>34</sup> Social interaction is therefore important for rabbits.<sup>36</sup>

(iv) The natural active behaviours of rabbits include foraging, hopping, running, chasing, playing, grooming, sitting up with ears erect, rearing, leaping and digging.<sup>7, 34, 36</sup> Periods of rest lasting several hours alternate with periods of activity.<sup>50</sup>

### Recommendations

*1.5.1 To meet the requirements of the Code of Practice (ie to provide accommodation that meets the species-specific needs of rabbits), housing should be provided which allows rabbits the opportunity for social interaction, the opportunity to carry out normal behaviours such as hopping and rearing upwards (freedom of movement) and the opportunity to rest and withdraw from each other.*

*1.5.2 The Code of Practice recognises that there may be circumstances where the requirements of experimental procedures will preclude meeting some species-specific needs (Clause 4.4.22 (ii)). Housing in these situations should still meet the physiological and psychological needs of rabbits as closely as possible.*

## 1.6 Definitions

**Pen** Enclosure for housing rabbits that allows for freedom of movement by rabbits and allows for the provision of a variety of environmental enrichment strategies.

**Cage** Fully enclosed container for housing rabbits which, because of its size, restricts freedom of movement by rabbits and limits the provision of environmental enrichment strategies. Cages are usually constructed from metal or plastic, with solid or mesh sides.

## 2. Group Housing in Pens

### 2.1 Advantages of Group Housing in Pens

#### Principles

The advantages of housing rabbits in groups in pens include:

- (i) Housing in pens provides increased space which allows rabbits freedom of movement to carry out normal activities such as hopping, stretching out, sitting up with ears erect, rearing, and leaping. Physical and psychological well-being is assisted by the opportunity to exercise and explore a complex environment.<sup>36</sup>
- (ii) Rabbits are social animals which benefit from the company of others. Housing rabbits in groups in pens allows for social interaction and behaviours such as grooming penmates, lying together and playing.<sup>36,37</sup> The behavioural repertoire of group housed rabbits is more varied compared to that of singly housed rabbits.<sup>5</sup>
- (iii) Pens provide a greater opportunity than cages for the environment to be enriched and made more behaviourally stimulating (for example by the addition of ledges for climbing on and areas for retreating into).<sup>5,37</sup>
- (iv) It is reported that the costs of setting up pens and maintaining rabbits in pens is less than for buying cages and maintaining rabbits in cages. Cost savings may be made in the areas of bedding, cleaning agents, maintenance, energy and labour.<sup>37</sup>
- (v) Health advantages include that sore hocks (pododermatitis) and gastrointestinal hair balls (trichobezoars) are rare or non-existent in penned animals.<sup>33,34,36</sup> The incidence of “snuffles” may also be reduced, possibly because of better ventilation than solid walled cages,<sup>37</sup> although an increased incidence of sneezing has been observed.<sup>44</sup> Thinning of the bones of the femur and spine because of inactivity may be seen in caged rabbits. This can result in a loss of ability to move normally, fractures, spinal distortions and discomfort from trapping nerves in the spine.<sup>30,37</sup> There is no evidence of such thinning of the bones, with its attendant complications, occurring in rabbits in pens.

### 2.2 Disadvantages of Group Housing in Pens

#### Principles

The disadvantages of housing rabbits in groups in pens include:

- (i) A high level of stockpersonship in caring for and monitoring rabbits is required. Thus animal carers need to be proficient in recognising all the different aspects of rabbit behaviour. This is so that both health and social interaction can effectively be monitored.<sup>36,37</sup>

- (ii) Fighting and bullying may occur, especially in mature males.<sup>12, 33, 37</sup> The grouping of rabbits may become unstable – there may be difficulties in reintroducing a rabbit that has been removed for even a short time. In addition, stable groups may become unstable, resulting in aggressive behaviour, for no obvious reason.<sup>37</sup> Fighting and aggressive behaviours may result in severe injuries and stress responses in subordinate animals.<sup>6, 55</sup>
- (iii) Rabbits may be difficult to catch in pens.<sup>33</sup>
- (iv) Identification of individual rabbits may be more difficult.<sup>37</sup>
- (v) Bedding disposal may cause a problem because of its volume.<sup>37</sup>
- (vi) Space may be wasted, especially vertical height.<sup>37</sup>
- (vii) There is the potential for disease spread.<sup>33</sup> However this has been reported not to be a problem in practice.<sup>33, 36</sup>
- (viii) It has been argued that rabbits in pens may be subject to more variables which may affect the interpretation of experimental results. This, however, needs to be weighed against the effects of obtaining data from rabbits, singly housed in cages, which may be physiologically and psychologically abnormal.<sup>17, 34, 36, 37</sup>

## **Recommendations**

*2.2.1 Rabbits should be housed in groups in pens.*

*2.2.2 Rabbits that cannot be housed in groups (eg intact males or for experimental reasons) should be housed in pens with olfactory, visual and, if possible, physical contact with adjacent rabbits.*

*2.2.3 Rabbits should only be housed in cages with the express permission of the Animal Ethics Committee of the institution on the basis of compelling evidence for the need to use such housing. In such cases, cages should be enriched by methods as described in this document (such as pair housing in double cages). Lack of space or facilities for pens should not be considered sufficient justification for the use of such cages.*

*2.2.4 Rabbits should not be housed singly in conventional (unenriched) cages except in exceptional circumstances and with the express permission of the Animal Ethics Committee of the institution on the basis of compelling evidence for the need to use such housing. Such circumstances may, for example, relate to research into the effects of such caging on rabbits. Lack of space or facilities for pens should not be considered sufficient justification for the use of conventional cages.*



## 3. Pen Design and Environment

### 3.1 Pen Construction

#### 3.1.1 Costs of Pens

##### Principles

(i) The cost of group housing in floor pens is likely to be considerably less than single housing in cages.<sup>34, 37</sup> Savings may be made in areas including cage washers (running, maintenance and servicing), chemicals (descalers and disinfectants) and staff time for cleaning (although some of the staff time saved will need to be spent monitoring and handling rabbits in pens).<sup>37</sup>

#### 3.1.2 Materials for Pens

##### Principles

(i) A variety of materials may be used, depending on the design of the pen. For example, the pen may occupy a whole room or be adapted from plastic bins made for other purposes or from pens for larger animals.<sup>5, 34</sup> Materials for pen walls may be solid (for example plastic) or be open weave (for example wire mesh) and opaque or transparent / translucent. Opaque solid walls between pens have the advantage of providing additional areas for shelter/privacy, but the disadvantages, as with all solid walls, of restricting air flow and of restricting vision of surroundings (including of rabbits in adjacent pens and people approaching).

##### Recommendations

*3.1.2.1 Materials used for pen construction should be safe and non-toxic for rabbits.*

*3.1.2.2 Materials used for pen construction should be easy to clean, water resistant and strong.<sup>12</sup>*

*3.1.2.3 For the front of the pen, material that allows rabbits to see out (for example wire mesh) is preferable to opaque material, as this allows rabbits to see who is approaching, which helps to eliminate fear responses.<sup>18, 36</sup>*

#### 3.1.3 Floor Area of Pens

##### Principles

(i) The age and activity level of rabbits is more important in determining space requirements than the weight or size of rabbits. For example, young rabbits need more space than adults for play behaviour.<sup>5, 36, 37</sup>

(ii) The minimum space provided should allow each rabbit to carry out its normal behaviour, including a wide range of locomotory behaviours, such as hopping, leaping, playing, exploring and stretching out.<sup>30, 33, 34, 37</sup> It has been suggested that the minimum space provided should allow rabbits to complete 3 hops in one direction. Adult New Zealand White rabbits have been measured travelling 1.5 – 2.0 metres in three “normal” hops. They will travel much further in three hops when startled.<sup>34</sup>

(iii) In addition to meeting minimum space requirements for movement, space should be provided to allow the provision of structural complexity and environmental enrichment in pens. For example, additional space should be provided to accommodate objects such as boxes and pipes, which provide rabbits with retreat / hiding areas.<sup>5, 37</sup>

### Recommendations

*3.1.3.1 A minimum **CLEAR** area of 2.0 square metres should be provided.<sup>37</sup> (See also 3.1.3.3 and Table 1)*

*3.1.3.2 A minimum length in one direction of 2.0 metres should be provided. (See also 3.1.3.3 and Table 1)*

*3.1.3.3 An overall minimum floor area of 0.75 – 0.8 square metres per rabbit should be provided for groups of up to 6 rabbits (with an absolute minimum floor area to be provided as in 3.1.3.1 and 3.1.3.2 above). For groups of more than 6 rabbits, space should be allocated at approximately 0.25 square metres per additional rabbit.*

*3.1.3.4 For a group of 6 – 8 rabbits a minimum floor area of 4.5 – 5.0 square metres should be provided.<sup>5</sup>*

**Table 1: Summary of space requirements**

No. of rabbits	Minimum space (m <sup>2</sup> ) (*ensuring a CLEAR area of 2m <sup>2</sup> and a minimum length in one direction of 2m)
1	2.00
2	2.00
3	2.25 - 2.40
4	3.00 - 3.20
5	3.75 - 4.00
6	4.50 - 4.80
7	4.75 - 5.05
8	5.00 - 5.30

### 3.1.4 Height of Pens

#### Principles

(i) Normal behaviour of rabbits includes rearing up on their hind legs and sitting up erect with their ears pricked.<sup>36</sup> Such erect stances allow rabbits to investigate sights and sounds.<sup>55</sup> The minimum height provided should allow rabbits to carry out these behaviours.<sup>19</sup>

(ii) Rabbits commonly sit on top of objects (for example ledges and nest boxes), viewing the environment from a raised area, and the minimum height provided should allow for this behaviour.<sup>19, 37</sup>

(iii) Rabbits are capable of jumping very high, and of using objects within a pen as “launching pads” to jump out of pens.<sup>37</sup>

## Recommendations

3.1.4.1 *If the pen is covered, a minimum height of 100cm should be provided. The minimum height should enable rabbits to sit on top of raised objects.*<sup>26</sup>

3.1.4.2 *If the pen is uncovered, a minimum height of 1.25 metres should be provided.*<sup>37</sup>

3.1.4.3 *The proximity and height of objects near the edges of pens should be taken into account in making a pen secure from escape.*

## 3.2 Bedding in Pens

### Principles

(i) Bedding ensures a clean, dry, comfortable lying area.<sup>37</sup>

(ii) Ideally bedding should be dust free, free of microbial or parasitic contamination, non-toxic, ammonia binding, non-traumatic and moisture absorbent.<sup>46</sup> In addition it is desirable for it to be cheap, readily available and easy to use and dispose of.<sup>51</sup>

(iii) The smell of bedding is important – some woods have resinous aromatic oils which affect rabbits' behaviour patterns by altering the olfactory field.<sup>37</sup> There is evidence that rabbits avoid sawdust and woodshavings.<sup>51</sup>

(iv) Straw has the advantage of doubling as a means of environmental enrichment as rabbits play with, nibble, manipulate and burrow in straw.<sup>37</sup> It has the theoretical disadvantage of being a potential source of microbial disease due to contamination. To overcome this, straw can be autoclaved, however, this is expensive and creates practical difficulties. It is reported that, in practice, the introduction of disease has not been a problem.<sup>37,51</sup> A drawback of straw is that it may not be as moisture absorbent as other bedding materials such as woodshavings.

(v) Shredded paper has the advantages that it is clean, dust free and odourless. However, it has poor absorbency qualities.<sup>51</sup> Rabbits have been shown to choose shredded computer paper over bare concrete floors, sawdust or woodshavings.<sup>51</sup>

### Recommendations

3.2.1 *Bedding should be provided.*

3.2.2 *Straw is the bedding of choice and should be supplied to a depth of at least 5cm.*<sup>51, 37</sup>

3.2.3 *Shredded paper is the next bedding of choice. It should be supplied to a depth of at least 2cm.<sup>37</sup> Because of its poor absorbency qualities, it is best to put shredded paper on top of multiple layers of newspaper.*

3.2.4 *Sawdust and wood shavings may be used. They should be supplied to a depth of at least 2cm.<sup>37</sup> If these materials are used they should not smell strongly and should be made*

*from non-resinated (softwood) timber. Autoclaving may remove odours that offend rabbits.*<sup>37</sup>

3.2.5 *To increase the moisture absorbent properties of bedding, while supplying material that can be manipulated and played with, a layer of wood shavings or sawdust may be used under straw (see also 3.2.4).*

### **3.3 Cleaning of Pens**

#### **Principles**

(i) Rabbits in pens stake out a toilet area - they urinate and defaecate in one corner, although faecal pellets may be scattered with the movement of rabbits in the pen.<sup>36</sup>

(ii) A balance needs to be struck between the human perception of the need for cleanliness and the level of disturbance to rabbits. A sense of smell appears to be very important to rabbits – social interactions related to sex, age, reproductive status, individual identity, hierarchy and mother/young relationships may be communicated via the olfactory environment.<sup>6,37</sup> Scent signals arise from urine and secretions from specialised scent glands (chin, inguinal, anal and Harderian glands).<sup>6</sup> It has been suggested that urination and scent marking carried out by rabbits in clean cages are attempts to restore an “optimum odour field”.<sup>34</sup>

#### **Recommendations**

3.3.1 *Frequency of cleaning will be influenced by factors including the type and depth of bedding, stocking rates and the efficiency of air exchange in decreasing levels of noxious gases.*

3.3.2 *Cleaning the toilet area (for example 3 or 4 times a week) is usually required in between completely changing the pen bedding.*<sup>36</sup>

3.3.3 *Two weeks is the longest recommended interval between complete changes of bedding.*<sup>37</sup>

3.3.4 *If a system of shredded paper over layers of newspaper is used, the newspaper needs to be changed at least twice weekly.*<sup>51</sup>

3.3.5 *A pen should ideally be washed and disinfected (with an odourless disinfectant) at least every month.*<sup>5</sup>

3.3.6 *Pens and rooms should be completely cleaned every time a room is cleared and new stock brought in. The floor should be washed and an odourless disinfectant used.*<sup>37</sup>

## 4. Rabbit Care and Management in Pens and Cages

### 4.1 Management of Rabbits in Groups

#### Principles

(i) The success of group housing rests largely with the skill and enthusiasm of the animal carers.<sup>52</sup> Carers must be able to monitor and assess rabbit behaviour and implement management strategies accordingly.

(ii) Some breeds are more aggressive than others. Dutch rabbits are usually more aggressive than New Zealand White rabbits, and are generally unsuitable for group housing.<sup>23, 37</sup> Lop rabbits are usually more docile than New Zealand Whites.<sup>37</sup> However, a stable group of rabbits cannot be guaranteed by selecting less aggressive breeds. The occurrence of aggression, which rabbits will be involved in aggressive encounters, and the severity and outcome of such encounters, can be difficult to predict.<sup>52</sup>

(iii) It is best to establish groups of rabbits when they are young (around the time of weaning), and at least before they reach puberty (which may begin as early as 2.5 months of age).<sup>26</sup> Ideally littermates should be used, although separate litters of similar age can be grouped. Large weight or age differences can result in aggression. All-female groups are more likely to be stable. Sexes should not be mixed (apart from breeding groups).<sup>34, 36, 37</sup>

(iv) Males can be housed in groups until they reach 3 – 4 months of age.<sup>5</sup> However, mature male rabbits fight and this fighting can result in severe injuries.<sup>33</sup> The lack of space in pens for rabbits to escape aggressive encounters makes it impossible to keep mature male rabbits in groups in pens.<sup>34</sup> After about 3 – 4 months of age, housing intact males together in the expectation that they will be separated before fighting starts is unsafe for the rabbits, as the outbreak of severe aggressive encounters is difficult to predict and may occur without warning.<sup>26</sup>

(v) Castration has been shown to be a viable alternative for housing males together. Castration should be carried out at about 10 weeks of age - ie before aggressive behaviour is shown.<sup>26, 34, 37</sup>

(vi) Some individuals may be highly aggressive. In such cases it may be necessary to remove the dominant or subordinate rabbit temporarily or permanently.<sup>37</sup>

(vii) It is important that rabbits are provided with sufficient space and objects to assist them to escape and hide from their aggressors. Objects such as boxes, pipes, ledges and vertical barriers provide means for hiding and escape. Sufficient objects should be provided to eliminate competition for such items.<sup>3, 23, 36, 37</sup>

(viii) Housing more than 6 – 8 rabbits together creates difficulties in developing and maintaining a stable hierarchical system.<sup>3, 5</sup> Limiting groups to this number also assists in monitoring animals for signs of bullying and ill health.<sup>37</sup>

(ix) It is very important to keep the composition of a group stable. Where individual rabbits need to temporarily be separated from a group, they should be housed so that visual contact between

the individual and the group can be maintained. This helps to ensure that they will be readily recognised and accepted as familiar members of the group when returned.<sup>7a</sup>

(x) In a group where a rabbit has been removed (for example for a scientific procedure) and then returned, rabbits should be closely monitored for signs of aggression (for example, chasing, fighting, fight wounds).<sup>37</sup>

### **Recommendations**

- 4.1.1 *For monitoring the behaviour of rabbits in pens and implementing rabbit management strategies, animal carers should have suitable qualifications and experience. Their skill and enthusiasm are important factors in the successful housing of rabbits in groups in pens.*
- 4.1.2 *Wherever possible, rabbits in groups in pens should be of similar age and weight, be the same sex (preferably female), and be litter mates or mixed together at an early age (around weaning).*
- 4.1.3 *Mature (uncastrated) male rabbits should not be housed together.*
- 4.1.4 *Sufficient space and objects (such as boxes, pipes, ledges and vertical barriers) should be provided to assist rabbits to escape and hide from aggressors. Sufficient objects should also be provided to eliminate competition for these items.*
- 4.1.5 *The number of rabbits in a group should be limited to 6-8 (with the exception of breeding groups) (see 4.9).*
- 4.1.6 *Where individual rabbits need temporarily to be separated from a group, they should be housed so that visual contact between the individual and the group can be maintained, to assist with reintroduction into the group.*

## **4.2 Regrouping / Establishing Groups from Caged Rabbits**

### **Principles**

(i) It is possible to regroup rabbits, but this requires particular care and intensive monitoring. It is important that rabbits are placed in a fresh neutral area to avoid home territory for any animals.

Additional measures include:

- \* Providing hiding places and breaking up clear areas so that rabbits can escape from each other;
- \* Placing wire partitions between pens to allow familiarisation between rabbits before they are mixed;
- \* Scattering faecal pellets and urine soaked litter from each rabbit in the new pen;
- \* Scattering food in the new pen to encourage foraging;
- \* Having the usual carer handle rabbits together in small groups before mixing.<sup>37</sup>

(ii) A method for regrouping rabbits using sedation has been described by Love 91. In this method rabbits are sedated (fentanyl and droperidol) and placed in a small holding cage, making sure pen mates are not next to each other. The important part of this process is that rabbits chin and rub against each other as they are recovering from sedation, thus spreading recognisable smells. Rabbits are then placed in a pen not previously used by any of the rabbits. Rabbits may display behaviours such as chasing but usually settle within 24 hours.<sup>33</sup>

(iii) Moving rabbits from cage housing to pens also presents particular problems. Rabbits that have been housed in cages for 6 months or more are prone to fighting (due to lack of social experience) and bone fractures due to osteoporosis.<sup>37</sup> Methods to assist in group housing such animals in pens include providing increasing daily periods of exercise individually and then in small groups, then housing in the group pen during the day and individually in cages at night and finally housing in the group pen. Even with such methods, signs of aggression need to be looked for. Groups may become unstable and may require the removal of individuals.<sup>47</sup>

### **Recommendations**

*4.2.1 Particular care should be exercised in regrouping rabbits or in moving rabbits from cage housing to group housing in pens.*

## **4.3 Catching / Handling of Rabbits in Pens and Cages**

### **Principles**

*(See also Section 4.9 Breeding (v) and 4.9.7)*

(i) Because pens provide room to escape, catching rabbits in pens may be difficult. Anticipation of what is to happen once caught plays a major role in a rabbit's behaviour. Therefore steps should be taken to reduce the stress of procedures and to catch and handle rabbits without conducting other procedures.<sup>34</sup> Animal carers should also spend time with the rabbits, which will facilitate catching.<sup>36</sup>

(ii) Rabbits show a reduction in fearfulness to handlers after repeated approach and handling. The use of handling and approach programmes may help reduce general emotional reactivity (not just fear of humans) and strengthen the human-animal bond.<sup>45</sup>

(iii) A quiet approach should be taken. Rabbits will usually retreat to a darkened hiding place from where they may be picked up.<sup>34</sup>

(iv) In one study, rabbits were trained to accept a procedure (oral administration of an antibiotic solution) without restraint when given positive reinforcement (drug delivered in a sugar coated syringe after a period of training by administering a sugar solution)<sup>34a</sup>.

### **Recommendations**

*4.3.1 To assist in catching rabbits, a quiet approach should be taken.*

*4.3.2 To assist in catching rabbits, a darkened retreat area from which rabbits may be picked up should be provided. For example, provide plastic pipes of about 20 – 25cm diameter, which can be upended to catch rabbits when they enter them.*

- 4.3.3 *It is important that rabbits are caught and handled on a regular basis (ideally daily and at least weekly) to facilitate ease of catching and to reduce fearfulness. Such catching and handling should be carried out in addition to catching and handling rabbits in order to conduct procedures.*
- 4.3.4 *The training and rewarding of rabbits using positive reinforcement or “treats” should be considered when performing procedures on rabbits. This is likely to reduce the stress on rabbits and increase their co-operation.*

## **4.4 Identification of Rabbits in Pens and Cages**

### **Principles**

(i) Clause 5.6.1 of the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes states:

The method of identification of individual animals must be that which causes the least distress within the context of the research proposal and the least interference with the normal functioning of the animal.

(ii) Ideally methods of identification should not be painful, not cause adverse reactions, not be uncomfortable and not likely to catch or tear out.<sup>37</sup>

### **Recommendations**

- 4.4.1 *The least invasive method of identification should be used that is compatible with the use of rabbits in the institution.*
- 4.4.2 *Coat colour and pattern is useful for the identification of individuals in some breeds of rabbits.*
- 4.4.3 *Dyes including permanent wool dyes, agricultural sheep sprays, fuchsin, acriflavine or gentian violet may be used. These need to be reapplied at intervals, as the dye fades or the rabbit moults.<sup>37, 56</sup>*
- 4.4.4 *Xylene free permanent markers may be used on ears and fur. Generally these need to be refreshed every 3 weeks.<sup>37</sup> The use of these markers on the inside of the ears is effective and different colours can be used for coding.*
- 4.4.5 *Fur clipping may be used but needs to be carried out frequently.<sup>37</sup>*
- 4.4.6 *Microchips and ear tattoos may be used for permanent identification.<sup>56</sup> Note there is some transitory pain associated with applying these forms of identification. Microchips can be inserted at 6 weeks of age. Anaesthesia or sedation and analgesia should be used in applying tattoos.<sup>37</sup>*
- 4.4.7 *Leg rings, fitted over the hock at about 6 weeks of age may be used. However, they need to be checked frequently while rabbits are growing (at least weekly) to ensure they do not become too tight.<sup>36</sup>*



- 4.4.8 *Studs or ear tags should not be used as they may tear out, they may cause infections leading to the growth of fibrous tissue as a chronic inflammatory response, and they are painful to insert.*<sup>37</sup>
- 4.4.9 *Collars should not be used as they may be chewed off by other rabbits, they may drop off and rabbits may catch their legs in them.*<sup>37</sup>
- 4.4.10 *Ear notching must not be used.*<sup>5</sup>

## **4.5 Food and Water for Rabbits in Pens and Cages**

### **Principles**

- (i) Dried pelleted diets have the advantages of being standardised with little variation. However, these diets are monotonous and their repetitive presentation without supplements (such as hay and green feed) may compromise the well-being of rabbits.<sup>5</sup>
- (ii) Scattering food reduces boredom by encouraging rabbits to forage. This reduces the amount of time available for fighting and helps to prevent obesity.<sup>37</sup>
- (iii) High fibre feed such as hay helps prevent diarrhoea and trichobezoars (hairballs). A diet with around 18 – 25% crude fibre is suggested.<sup>43</sup> Hay also provides something to manipulate and play with.<sup>37</sup>

### **Recommendations**

- 4.5.1 *A nutritionally adequate diet should be provided for rabbits.*
- 4.5.2 *It is recommended that more than one source of food and water be provided to reduce the possibility of aggressive competition.*<sup>34</sup>
- 4.5.2 *Dried pelleted diets should be fed at around the amount of 60 – 80 g/kg/day depending on factors such as the age of rabbits and their opportunities for exercise. To relieve boredom, more than one formulation may be fed.*
- 4.5.3 *Hay should be fed on a daily basis.*
- 4.5.4 *For variety, pelleted food should be supplemented with items such as fruit and vegetables, corn, barley, oats and soya beans. Fruit and vegetables should be washed to reduce the risk of introduction of disease.*<sup>37</sup>
- 4.5.5 *Food may be spread out to encourage rabbits to forage. Food may be scattered or placed in small piles around the pen. Fouled or uneaten food should be removed daily.*<sup>37</sup>
- 4.5.6 *If a restricted diet is required to be fed, it should be provided in the late afternoon (which has been shown to reduce the frequency of abnormal behaviours in caged rabbits).*<sup>29</sup>

4.5.7 *A plentiful supply of clean water should always be available. Various systems to supply water may be used. If automatic watering systems or water bottles are used, care should be taken to avoid leakage and overflows. Open water systems (such as chicken water hoppers) should be raised up to prevent water being contaminated with bedding and faeces.*<sup>37</sup>

## 4.6 Monitoring of Rabbits in Pens and Cages

### Principles

(i) A high standard of animal care is crucial for the success of housing rabbits in groups in pens. Rabbits must be monitored both for health and for social interactions within the group.

(ii) In cages normal behaviours are difficult to assess (because it is difficult or impossible for rabbits to carry out these behaviours) and changes in food and water intake are often the only early indicator of illness.<sup>34</sup>

### Recommendations

4.6.1 *Rabbits should be monitored by observation at least daily.*

4.6.2 *Weekly health checks of all rabbits should be carried out by animal carers (in addition to daily observation – see 4.7.2).*

4.6.3 *Animal carers should be aware of the normal behaviour of rabbits and of the individuals within a group and observe for deviations from normal.*<sup>34</sup>

4.6.4 *In particular, subordinate rabbits should be monitored for signs of bullying (which may, for example, result in fight wounds or denial of access to food or water).*<sup>34, 4</sup>

4.6.5 *Rabbits that give cause for concern (either excessively aggressive or timid) may need to be removed from a group.*

4.6.6 *To ensure that individuals can be adequately monitored, group sizes should not exceed 6 - 8 rabbits.*<sup>37</sup>

## 4.7 Health of Rabbits in Pens and Cages

### Principles

(i) Evidence indicates that infectious disease spread in rabbits housed in groups in pens is no more of a problem than for animals housed singly in cages, providing high standards of care and monitoring are maintained. Possible routes for disease spread include direct contact and shared food and water containers.<sup>33, 36, 55</sup> Unless people exercise extreme care going between singly caged rabbits and unless the ventilation is carefully controlled and directed, the spread of infection could occur equally under single housed or group penned systems.<sup>37</sup>

**(ii) *Coccidiosis***

Outbreaks of primary coccidiosis are not commonly observed and many grouped rabbits are not fed coccidiostat supplements because of their potential effects on experimental procedures. It is thought that the combination of high standards of care and low stress enables an immunity to develop.<sup>37</sup>

**(iii) *Trichobezoars (hairballs)***

Hairballs and perforated gastrointestinal tract ulcers are rare in penned rabbits. The increased incidence in caged rabbits is thought to be due to factors including lack of exercise, lack of roughage and pathological grooming due to isolation and boredom.<sup>33, 34, 36</sup>

**(iv) *Pododermatitis (sore hocks)***

Sore hocks are rare or non-existent in penned rabbits.<sup>36</sup> Certain types of cage flooring (for example grids) are linked with the occurrence of sore hocks.<sup>37</sup>

**(v) *Pasteurella multocida (snuffles)***

The incidence of snuffles may be reduced in penned rabbits, possibly because of better ventilation in pens compared to solid walled cages.<sup>37</sup> (In one study an increased incidence of sneezing was observed in rabbits in pens, but the cause of this was not confirmed).<sup>44</sup>

**(vi) *Fighting injuries***

Fighting injuries may occur in group housed rabbits. In stable groups these are mostly confined to minor skin abrasions and occasional abscesses.<sup>37</sup> Where conflicts are violent, severe and even fatal injuries can occur.

**(vii) *Bone thinning***

Thinning of the bones of the femur and spine, because of inactivity, may be seen in caged rabbits.<sup>13a, 30, 37</sup> The bone thinning will occur within 4-6 weeks of confining rabbits in cages (Drescher B pers comm). This can result in a loss of ability to move normally, fractures, spinal distortions and discomfort from the trapping of nerves in the spine.<sup>13a, 30, 37</sup> There is no evidence of such thinning of the bones, with its attendant complications, occurring in rabbits in pens.<sup>30, 37</sup> The bone thinning is reversible once rabbits are placed in pens which allow normal movement (Drescher B pers comm).

**(viii) *Calicivirus***

Calicivirus causes signs ranging from transient apathy to death with widespread haemorrhages.<sup>5, 20</sup> It is transmitted by direct contact between rabbits, or by transportation of the virus by clothing, other objects, people and animals.<sup>5, 14, 20</sup> Insects such as flies and mosquitoes also act as vectors for the disease.<sup>2, 11</sup>

**(ix) *Myxomatosis***

Myxomatosis is caused by a myxoma (pox) virus and results in characteristic signs including swelling and closure of the eyelids and a thick mucopurulent eye discharge and subcutaneous swellings especially around the face and ears. A progressive loss of condition usually results in death in 11 – 18 days.<sup>5, 20</sup> It is spread by direct contact or insects (fleas and mosquitoes).

**(ix) Ear mites (*Psoroptes cuniculi*)**

Ear mites cause intense local irritation, head shaking and scratching. They result in a yellowish brown exudate accumulating within the ear canal. They are spread by direct contact and indirectly through environmental contamination. Adult mites can survive off the host for a week or more.<sup>1a, 20, 53a</sup>

**Recommendations**

- 4.7.1 *Rabbits introduced into group housing should be free of *Pasteurella multocida*, ear mites and coccidia.*<sup>21</sup>
- 4.7.2 *A health monitoring programme should be instituted and health checks of individual rabbits should be carried out at least weekly. Health checks should include looking for signs of malocclusion, overgrown claws, fight wounds (especially underbelly wounds), sore hocks, ear mites, diarrhoea and snuffles.*<sup>22</sup> *Weekly weighing should be carried out.*<sup>34</sup>
- 4.7.3 *Rabbits should be vaccinated against *Calicivirus*<sup>5</sup> and protected from insects which may act as vectors for *Calicivirus*.*
- 4.7.4 *Rabbits should be protected from insects such as mosquitoes which may act as vectors for myxomatosis.*

**4.9 Breeding of Rabbits in Pens and Cages****Principles**

- (i) Problems that occur in breeding systems which house rabbits in cages include very limited freedom of movement, stereotypies, restlessness, disturbed sexual behaviour, disturbed nursing and cannibalism.<sup>50</sup>
- (ii) Breeding groups of 2 - 5 females, one male and their offspring until weaning can successfully be managed in pens.<sup>37, 50</sup>
- (iii) Nest quality can affect the survival of young especially in the first two weeks of life. Does have been found to build better nests if provided with soft nesting materials of natural fibre (such as cashmere or camel hair). Such materials promote a better microclimate (temperature and humidity) within the nest and may be more comfortable for young rabbits.<sup>53</sup> Fibre content of the diet of the doe also has a strong influence on nest quality, with inadequate fibre having a detrimental effect.<sup>27</sup>
- (iv) Normal behaviour of female rabbits is to visit their nestlings once a day for nursing, open the nest entrance each time, and close it again afterwards.<sup>31</sup>
- (v) The handling of young rabbits helps to reduce fearfulness towards humans and general emotional reactivity, as well as increasing “open field” activity and exploratory behaviour.<sup>8, 13, 25, 28</sup>

Handling in the first week of life and at a time associated with nursing may be especially effective in reducing fearfulness towards humans. The effect of this handling appears to be long-lasting.<sup>8</sup>

(vi) Males will mate with females immediately after they have given birth. There are differing opinions on the effect of such breeding and the subsequent rapid succession of litters on the welfare of the female breeders.<sup>37, 50</sup>

## **Recommendations**

*4.9.1 For group housing breeding rabbits in pens the following are recommended for inclusion in the pen design:*

- \* A central area where rabbits can rest*
- \* A feeding area with several sources of food and water*
- \* A nesting area with separate nesting boxes with tunnel-like entrances (which substitute for breeding burrows dug in the earth and allow closing of the nest by the female), straw bedding and barriers between each nest to obscure the view of adjacent nests (and thus limit aggressive behaviour)*
- \* A pup area with small entrance passages accessible to rabbits up until about weaning age (about 18- 39 days)*
- \* An isolation area (which is needed to separate the male from time to time and for sick females) which allows sight and olfactory contact with rabbits in the main pen.<sup>50</sup> (See Figure 1)*

*4.9.2 One nesting box per female should be provided to enable each female to nest alone.<sup>37</sup>*

*4.9.3 Nest boxes of about 38cm x 25cm and 20cm high are recommended (females may urinate in boxes if they are too large).<sup>37</sup>*

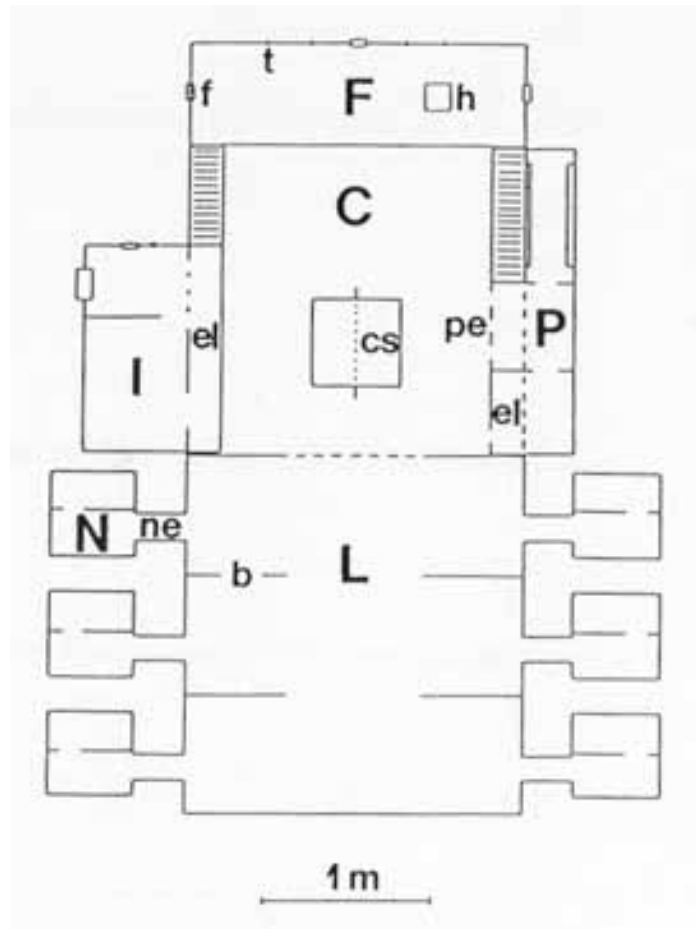
*4.9.4 Females should be provided with straw or other suitable material such as hay or shredded paper to spread in their nesting place.<sup>43, 50</sup>*

*4.9.5 Females should be able to withdraw from their young by retreating to a separate compartment or raised area,<sup>50</sup> and / or by closing the nest after nursing.*

*4.9.6 For a breeding group of 4-5 females, one male and their offspring, a floor area of 9 square metres is recommended.<sup>18</sup>*

*4.9.7 The handling of young rabbits is recommended to reduce fearfulness.<sup>8, 25, 28</sup>*

*4.9.8 If immediate post-partum mating is carried out, it should be ensured that the doe is in a suitable condition to sustain her pregnancy without jeopardising her health.<sup>37</sup>*



C	central area	b	blind
F	feeding area	cs	central structure
I	Isolation cage	el	raised resting space
L	bedded nesting area	f	pellet feeder
N	nesting box	h	hay rack
P	pup area	ne	tunnel-like nest entrance
		pe	entrance to pup area
		t	drinker

**Figure 1 Rabbit housing system for breeding groups**

(Reproduced with kind permission from: Stauffacher (1992) Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal Welfare 1*: Figure 1 page 114; Publisher: UFAW, The Old School, Brewhouse Hill, Wheathampstead, Herts AL4 8AN, UK)

## 5. Single Housing in Cages

### 5.1 Advantages of Single Housing in Cages

#### Principles

The advantages of housing rabbits singly in cages include:

- (i) Food and water intake can be controlled and monitored.<sup>37</sup>
- (ii) Faeces and urine excretion can be quantified and monitored.<sup>37</sup>
- (iii) Rabbits can be identified without the need to mark them.<sup>37</sup>
- (iv) If strict precautions are taken, the spread of infection may be controlled more easily than group housed rabbits.<sup>37</sup>
- (v) It is easier to maintain a cleaner environment.<sup>37</sup>

### 5.2 Disadvantages of Single Housing in Cages

#### Principles

The disadvantages of housing rabbits singly in cages include:

- (i) Space restrictions in cages mean that rabbits cannot carry out normal activities such as hopping, lying stretched out, sitting up with ears erect, rearing and leaping.<sup>26, 34, 36</sup>
- (ii) The behavioural repertoire of singly caged rabbits is severely restricted, largely as a result of social deprivation.<sup>5</sup>
- (iii) Singly housed rabbits in cages carry out a variety of stereotypic behaviours such as bar gnawing, hopping back and forth, excessive grooming, fur eating, playing with the water nipple, pawing in the corners, head swaying and vertical sliding of the nose between the bars. Additional behaviours that have been observed include sitting in a hunched position for long periods and sitting with the head lowered in a corner. Rabbits also exhibit “restlessness” in cages – a high frequency of changing from one activity to another. It is likely that such behaviours are the result of frustration, anxiety, and boredom related to a barren, confined environment.<sup>5, 7, 16, 17, 29, 30, 32, 36, 37, 44, 47, 50</sup> These behaviours are rarely if ever seen in rabbits housed in groups in pens.<sup>16, 29, 45</sup>
- (iv) Singly caged rabbits tend to over react to relatively small changes in the environment. Such changes are likely to be a source of stress to the rabbits and they may become nervous and take fright or become aggressive. Such behaviour may relate to a chronic lack of stimulation and/or to the fact that they have no way of escaping and hiding.<sup>30, 35, 54</sup>

- (v) It is difficult to provide environmental enrichment in cages because of space restrictions.<sup>37</sup>
- (vi) Frequent cleaning and sterilisation may disturb the olfactory environment of the rabbit.<sup>37</sup>
- (vii) Ventilation may be poor in solid sided cages.<sup>36, 37</sup>
- (viii) Health problems which are relatively common in caged rabbits and rare or unseen in penned rabbits include trichobezoars (hairballs) and gastrointestinal ulcers, pododermatitis (sore hocks), obesity and osteoporosis which may lead to a loss of capacity for normal locomotion, bone fractures and spinal distortion.<sup>30, 33, 34, 36, 37</sup>
- (ix) Cages are expensive to buy and costly and time consuming to clean.<sup>37</sup>
- (x) Singly housed rabbits in cages may be psychologically and physiologically abnormal. The use of such animals in research may have an influence on experimental results.<sup>17, 34, 36, 37</sup>

## 6. Cage Design and Environment

### 6.1 Cage Construction

#### 6.1.1 Materials for Cages

##### Principles

- (i) Cages are usually constructed from metal (stainless steel or aluminium) or plastic.<sup>5</sup>
- (ii) Wire cages have the advantages that rabbits can see all around them and they are quieter than solid metal when rabbits move around. They may also allow rabbits in adjacent cages to communicate, not only by sight but by odours and urine spraying. Wire cages also provide good ventilation. However, such cages provide no darkened hiding or retreat area.<sup>37</sup>

##### Recommendations

*6.1.1.1 Cages may be constructed from materials including metal or plastic.*

*6.1.1.2 Open sided (eg wire) cages are recommended, although a hiding / retreat area should be provided in such cages.*

#### 6.1.2 Flooring for Cages

##### Principles

- (i) Wire / grid floors are associated with a high incidence of sore hocks, especially in heavier rabbits.<sup>34, 37</sup>
- (ii) Dimple floors are probably the best for the comfort and health of rabbits. Rabbits lie stretched out on plastic flooring and it is probably more comfortable than metal and subjects rabbits to less heat loss.<sup>5, 37</sup> However, plastic flooring may also be more slippery than metal, which may make it difficult for rabbits to move around within the cage. (Rose M 2001 pers com)



## Recommendations

*6.1.2.1 Plastic or metal dimple flooring should be used in cages.*

### 6.1.3 Floor Area of Cages

#### Principles

(i) Ideally cages should allow rabbits to stretch fully in all directions in the cage (length, width and diagonal).<sup>15,37</sup> An adult New Zealand White rabbit is approximately 80cm long when fully stretched out.<sup>7a</sup> To allow freedom to stretch out in any direction, a floor area of 0.6 square metres (0.8 metres x 0.8 metres) would be required.<sup>15</sup>

(ii) Larger cages may be difficult to manage (for example to catch rabbits and to clean).<sup>5,37</sup>

#### Recommendations

*6.1.3.1 Minimum cage floor dimensions of 0.8 meters width x 0.8 metres depth (0.64 square metres) should be provided.*

*6.1.3.2 A minimum clear space in one direction of 0.8 metres should be provided.*

*6.1.3.2 Additional clear space and larger caging (as compared to recommendation 6.1.3.1 and 6.1.3.2) is recommended to allow for the provision of additional environmental enrichment.<sup>5</sup>*

### 6.1.4 Height of Cages

#### Principles

(i) Normal behaviour of rabbits includes rearing up on their hind legs and sitting up erect with their ears pricked.<sup>36</sup> Such erect stances allow rabbits to investigate sights and sounds.<sup>55</sup> The minimum height provided should allow rabbits to carry out these behaviours.<sup>19</sup> A suitable height to allow a New Zealand White rabbit to carry out such behaviours would be 75cm.<sup>18,37</sup> However, in practical terms it may be difficult to make and use such cages.<sup>37</sup> A cage height of 60cm would at least allow New Zealand White rabbits to sit up with their ears pricked.<sup>18</sup>

#### Recommendations

*6.1.4.1 Ideally the cage height should allow rabbits to rear up erect on their hind legs with their ears pricked (75cm for a New Zealand White rabbit).*

*6.1.4.2 Although ideally cage height should be greater (see 6.1.4.1), a minimum cage height of 60cm should be provided.*

## 6.2 Cage Trays

#### Principles

(i) Most cages have trays underneath which catch urine and faeces. The contents of the tray are important because odours will diffuse up into the cages. Materials that are used in trays include

sawdust, woodshavings, corrugated paper, pelleted paper, paper sprinkled with absorbent powders, preformed cardboard trays and absorbent pads.<sup>37</sup>

(ii) Systems in which urine and faeces are drawn under the cages of other rabbits (eg winding paper towels) may be stressful to rabbits because of the odours and may cause reproductive inhibition.<sup>37</sup>

### **Recommendations**

*6.2.1 Materials that may be used in cage trays for catching urine and faeces include sawdust, woodshavings, corrugated paper, paper sprinkled with absorbent powders, pelleted paper, preformed cardboard trays and absorbent pads. If sawdust or woodshavings are used they should not smell strongly and should be made from non-resinated (softwood) timber. Autoclaving may remove odours that offend rabbits.<sup>37</sup>*

## **6.3 Cleaning of Cages**

### **Principles**

(i) A balance needs to be struck between the human perception for the need for cleanliness and the level of disturbance to rabbits.<sup>37</sup>

### **Recommendations**

*6.3.1 It is recommended that trays be cleaned and tray material be replaced three times a week.<sup>37</sup>*

*6.3.2 It is recommended that cages be cleaned every one to two weeks.<sup>5</sup>*

*6.3.3 Concentrations of ammonia should be monitored at the level of the cages and should ideally be lower than 1-2ppm and not allowed to exceed 10ppm.<sup>5</sup>*

# **7. Environmental Enrichment for Rabbits in Pens and Cages**

## **7.1 Environmental Enrichment for Rabbits in Pens**

### **Principles**

(i) Environmental enrichment has been defined as “any measure which promotes expression of natural, species specific behaviours and a decrease in, if not disappearance of, abnormal behaviours”.<sup>9,49</sup> It should be aimed not just at preventing suffering but at having a positive effect on the physical and psychological well-being of the rabbit.<sup>36</sup>

(ii) When techniques are used in an effort to provide environmental enrichment for rabbits it is important that the success of the techniques, in terms of improving the rabbits’ welfare, is evaluated.

(iii) In accordance with the requirement of the Code of Practice that housing should take into account species-specific behavioural needs (Clause 4.4.22), the implementation of strategies to

provide environmental enrichment for rabbits should be regarded as a fundamental requisite of rabbit care and management.

(iii) Environmental enrichment strategies will extend over all facets of rabbit housing from pen design to food provision, opportunities for social contact and the provision of objects for manipulation. The recommendations listed below are therefore in addition to other recommendations throughout the document which contribute to enrichment of a rabbit's environment

(iv) Rabbits like to sit on elevated areas such as ledges and nest boxes.<sup>34, 37</sup>

(v) It is important for rabbits to be able to hide and to get away from each other.<sup>19, 26, 37</sup>

(vi) Rabbits play with and chew hay, straw and various objects.<sup>37</sup>

### **Recommendations**

***These recommendations should be read in conjunction with other recommendations throughout the document which contribute to the enrichment of a rabbit's environment, and in particular, recommendations 2.2.1 and 2.2.2 concerning group housing.***

4.8.1 *Rabbits should be provided with objects such as ledges, boxes, PVC pipes and bales of straw which will create elevated areas for sitting on and darkened areas for hiding in. Sufficient objects should be provided to allow use by all rabbits and eliminate competition for use of the objects. Raised areas for lying on should be large enough to hold more than one rabbit as rabbits like lying together.*<sup>34</sup>

4.8.2 *Rabbits should be provided with hay and / or straw that can be used for chewing, digging, hiding and building nests.*

4.8.3 *A variety of food should be provided. (See section 4.5 Food and Water) Food may be spread out in the bedding to encourage foraging behaviour.*

4.8.4 *Rabbits should be provided with objects to manipulate and gnaw such as wooden sticks, branches with leaves and small cardboard boxes.*

## **7.2 Environmental Enrichment for Rabbits in Cages**

### **Principles**

***See also Section 7.1 Environmental Enrichment for Rabbits in Pens.***

(i) The provision of hay reduces abnormal behaviour and gives singly housed rabbits an alternative occupation.<sup>32</sup>

(ii) Providing rabbits with objects to manipulate triggers species-typical behaviours, reduces stereotypical behaviours and results in increased activity by rabbits.<sup>10, 24, 18</sup>

## **Recommendations**

*These recommendations should be read in conjunction with other recommendations throughout the document which contribute to the enrichment of a rabbit's environment, and in particular, recommendations 2.2.1 – 2.2.4 concerning group and cage housing.*

- 7.1.1 *Rabbits housed in cages should be provided with environmental enrichment.*
- 7.1.2 *Caged rabbits should be housed in compatible pairs wherever possible. This will usually require the use of double cages. Cages may, for example, be joined by a PVC pipe which also acts as a hiding / resting area. The floor space provided for pair housed rabbits should be greater than that provided for single caged rabbits and at least 1.2 metres x 0.8 metres.*
- 7.1.3 *Caged rabbits should have visual and olfactory contact with other rabbits. If rabbits are held in solid sided cages, they should be placed so that the rabbits can view other rabbits.*
- 7.1.4 *Rabbits should be provided with ledges and / or nest boxes which will create an elevated area for sitting on and a darkened area for hiding in. To increase the available area for rabbits, nest boxes can be attached to the outside of the cage. Increasing the height of part or all of the cage to accommodate ledges and boxes will increase the available vertical space for rabbits. Ideally ledges should be placed 20 – 30 cm from the floor of the cage and the overall cage height should be 60cm to accommodate this.*
- 7.1.5 *Rabbits should be provided with hay on a daily basis. To reduce wastage and the need for more frequent cage cleaning, this can be provided, for example, in a hay rack or in a plastic bottle. In the latter, rabbits will spend time manipulating the bottle to get the hay out.*
- 7.1.6 *Rabbits should be provided with objects to manipulate and gnaw such as wooden sticks, branches with leaves and small cardboard boxes. To provide variety objects may, for example, be hung from the top of the cage.*
- 7.1.7 *A variety of food should be provided. (See Section 4.5 Food and Water)*
- 7.1.8 *If a restricted diet is required to be fed, it should be provided in the late afternoon (which has been shown to reduce the frequency of abnormal behaviours in caged rabbits).<sup>29</sup>*
- 7.1.9 *Rabbits should be taken out of cages on a regular basis for handling / petting and exercise to relieve boredom.<sup>36</sup> Allowing rabbits periods of access to floor pens will assist in providing the opportunity for exercise.*

## 8. Environmental Variables in Pens and Cages

### 8.1 General

#### Principles

A variety of environmental factors, including light, temperature, humidity, air quality and sound may impact on the behavioural responses and health of rabbits. The design, construction and management of rabbit pens and cages will largely determine how these factors will impact on the rabbits.<sup>48</sup>

### 8.2 Light

#### Principles

(i) In the wild, rabbits are nocturnal, and forage mainly at dusk and dawn.<sup>5,7</sup> There is uncertainty as to whether rabbits in the laboratory are diurnal, nocturnal or crepuscular.<sup>3</sup> It appears that external noise or scheduled feeding during the day can turn laboratory rabbits into predominantly diurnal animals.<sup>5</sup>

(ii) It may be desirable, particularly when working with albino rabbits, to maintain a low light level except when brighter light is required for working in the room.<sup>5,37</sup>

(iii) There is debate about whether it is desirable to create an artificial dawn and dusk period.<sup>5</sup>

#### Recommendations

8.2.1 *A regular light / dark cycle should be provided,<sup>5</sup> and a 12/12 light/dark cycle is recommended.<sup>56</sup>*

8.2.2 *If rabbits are to be used for breeding, a 14 to 16 hour light period is recommended.<sup>43</sup>*

### 8.3 Temperature

#### Principles

(i) Low temperatures are fairly well tolerated by rabbits but heat and draft are not well tolerated. Temperatures of above 30°C, combined with high relative humidity, can cause heat stress which may result in infertility and mortality.<sup>56</sup>

(ii) Air temperature in the pen or cage is influenced not only by the design of the enclosure but also by air distribution, ventilation rate, the position of the enclosure within the air flow pattern and its proximity to other enclosures.<sup>48</sup>

#### Recommendations

8.3.1 *A temperature range for rabbit housing of 15 – 21°C is recommended.<sup>5,56</sup>*

### 8.4 Humidity

#### Recommendations

8.4.1 *A relative humidity for rabbit housing of 45 – 65% is recommended.<sup>5,20</sup>*

## 8.5 Air Quality

### Principles

(i) The effective ventilation of rabbit enclosures is a critical consideration in the management of environmental factors. The adequacy of air exchange in the rabbits' immediate environment of the pen or cage will affect temperature, humidity and air quality. The placement of air inlets and outlets in a room and the rate of air exchange will affect the pattern and efficiency of air distribution.<sup>48</sup>

(ii) The number of air changes per hour that are needed will in part be determined by the cleaning routine and stocking density of rabbits.<sup>5</sup> Air changes are less important than creating an efficient air flow to keep ammonia levels within the rabbits' immediate environment of the pen or cage at an acceptable level.<sup>42</sup>

### Recommendations

8.5.1 *A ventilation rate of 15 – 20 air changes per hour is recommended. Lower rates of air change may be acceptable if the cleaning routine is frequent and of a high standard and the stocking density is low.<sup>5</sup> The number of air changes per hour that are needed will be influenced by the air flow patterns at the level of the pen or cage.*

8.5.2 *Concentrations of ammonia should ideally be lower than 1-2ppm and not allowed to exceed 10ppm.<sup>5</sup>*

## 8.6 Sound

### Principles

(i) Rabbits are sensitive to high sound frequencies which cannot be detected by humans (ultrasound). Ultrasound can be produced by common laboratory equipment such as temperature regulating devices, cage cleaning equipment, vacuum hoses as well as by running water.<sup>5, 37</sup> The effect on rabbits of sound levels of elevated intensity is unclear. Some research has shown levels of 112 decibels to be stressful,<sup>39</sup> whereas another study did not demonstrate effects with sound levels of 96 decibels.<sup>41</sup>

### Recommendations

8.6.1 *Sources of ultrasound should be considered when assessing sound levels that rabbits are exposed to.*

8.6.2 *The effect of background radio noise to alleviate the effects of ultrasound and loud noises is unclear. If a radio is used, the volume should be kept low.*

## 9. Records

### 9.1 Pen / Cage Labels

#### Requirements

9.1.1 *Pens and cages should have labels attached to them that provide the following information:*

- \* *Rabbit identification*
- \* *Name, location and contact numbers of the Chief Investigator / Teacher and (if applicable) other investigators / teachers using the rabbits*
- \* *Name, location and contact numbers of staff associated with the housing and care of the rabbits*
- \* *Name and approval number of protocol in which rabbits are being used*
- \* *Age (date of birth) of rabbits*
- \* *Date of entry of rabbits into the pen or cage.*

### 9.2 Breeding Records

#### Principles

(i) Clause 4.5.8 (ii) if the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes states:

The person-in-charge must ensure that adequate records are maintained of the fertility, fecundity, morbidity and mortality in breeding colonies, in order to monitor the management of colonies, and to assist detection of the origin and spread of disease.

(ii) ARRP Guideline 16: *Supervision of Animal Supply by Animal Ethics Committees* details the types of records that should be kept, and information that should be provided to the Animal Ethics Committee, on animal breeding activities.

#### Requirements

9.2.1 *To assist in monitoring the management of rabbit breeding colonies, regular reports must be provided to the Animal Ethics Committee, for review, on the fertility, fecundity, morbidity and mortality of all rabbit breeding colonies. The frequency of such reports should be at least 6 monthly and more often if deemed necessary by the AEC. (See ARRP Guideline 16: Supervision of Animal Supply by Animal Ethics Committees)<sup>1</sup>*

## 10. References

1. Animal Research Review Panel (2001) ARRP Guideline 16: Supervision of Animal Supply by Animal Ethics Committees. [www.agric.nsw.gov.au/reader/7787](http://www.agric.nsw.gov.au/reader/7787)
- 1a. Anon (1999) Psoroptes mites in rabbits. *Provet Healthcare Information*. <http://www.provet.co.uk/health/diseases/rabbitpsoroptes.htm>
2. Asgari S, Hardy JRE, Sinclair RG and Cooke BD (1998) Field evidence for mechanical transmission of rabbit haemorrhagic disease (RHDV) by flies (Diptera: Calliphoridae) among wild rabbits in Australia. *Virus Research* 54: 123 – 132

3. Batchelor GR (1995) Group housing on floor pens and environmental enrichment in sandy lop rabbits (II): the 24 hour time budget of group housed rabbits. *Animal Technology* 46 (3): 167 – 190
4. Batchelor GR (1995) Bodyweight changes in laboratory rabbits subjected to transport and different housing conditions. *Animal Technology* 46 (2): 89 – 95
5. Batchelor GR (1999) The laboratory rabbit. *UFAW Handbook on the Care and Management of Laboratory Animals 7<sup>th</sup> Edition (Poole T Ed):* 395 - 408
6. Bell DJ (1984) The behaviour of rabbits: implications for their laboratory management. In *Standards for Laboratory Management Part 2: Proceedings of UFAW Symposium, UFAW, Potters Bar, England* 151 – 162
7. Berthelsen H (1999) The effect of hay on the behaviour of caged rabbits (*Oryctolagus cuniculus*). *Animal Welfare* 8: 149 – 157
- 7a. Boers K, Gray G, Love L, Mahmutovic Z, McCormick S, Turcotte N and Zhang Y (2002) Comfortable quarters for rabbits in research institutions. *Comfortable Quarters for Laboratory Animals 9<sup>th</sup> Edition (Reinhardt V and Reinhardt A Eds):* pp 1 – 13  
([www.awionline.org/pubs/cq02/cqindex.html](http://www.awionline.org/pubs/cq02/cqindex.html))
8. Bilko A and Altbacker V (2000) Regular handling early in the nursing period eliminates fear responses towards human beings in wild and domestic rabbits. *Dev. Psychobiol.* 36: 78 - 87
9. Brinkman C (1996) Toys for the Boys: Environmental enrichment for singly housed adult male macaques (*Maca fascicularis*). *Laboratory Primate Newsletter* 35 (2): 5 – 14  
([www.brown.edu/Research/Primate/lpn35-2.html](http://www.brown.edu/Research/Primate/lpn35-2.html))
10. Brooks DL, Huls W, Leamon C et al (1993) Cage enrichment for female New Zealand White rabbits. *Lab Animal* 22 (5): 30 – 38
11. CSIRO Rabbit control and rabbit calicivirus disease – A field handbook for land managers in Australia.  
([www.csiro.au/communication/rabbits/rabbits.htm](http://www.csiro.au/communication/rabbits/rabbits.htm))
12. Davys JS (1994) The floor pen for laboratory animals – A mixed blessing? *Animal Technology* 45 (2): 95 – 100
13. Denenberg VH, Wyly MV, Kennedy Burns J and Zarrow MX (1973) Behavioral effects of Handling Rabbits in Infancy. *Physiology and Behaviour* 10: 1001 - 1004
- 13a. Drescher B (1992) Housing of rabbits with respect to animal welfare. *Journal of Applied Rabbit Research* 15: 678-683
14. Embury I (1995) Rabbits- starting in pets or production. *Agfact NSW Agriculture A9.2.5:* 1 - 2
15. Eveleigh JR (1988) The development of rabbit, guinea pig and mouse cages. *Animal Technology* 39 (2): 107 – 116
16. Gunn D and Morton DB (1993) The behaviour of single caged and group housed laboratory rabbits. *Proceedings of the Fifth FELASA Symposium: Welfare and Science, Brighton* pp 80 – 84
17. Gunn D and Morton DB (1995) Inventory of the behaviour of New Zealand White rabbits in laboratory cages. *Applied Animal Behaviour Science* 45: 277 – 292
18. Gunn-Dore D (1997) Comfortable quarters for laboratory rabbits. In: *Comfortable Quarters for Laboratory Animals, Eighth Edition Reinhardt V (ed) Animal Welfare Institute Washington* pp 46 – 54  
([www.awionline.org/pubs/cq/five.pdf](http://www.awionline.org/pubs/cq/five.pdf))



19. Hansen LT and Berthelsen H (2000) The effect of environmental enrichment on the behaviour of caged rabbits (*Oryctolagus cuniculus*). *Applied Animal Behaviour Science* 68: 163 - 178
20. Harris I (1994) The Laboratory Rabbit *ANZCCART News* 7 (4 Insert): 1 - 8
21. Harris IE, Reilly JS, Blackshaw JK et al (1995b) Rabbits: Physiological and behavioural housing requirements (Part 2). *ASLAS Newsletter* Spring/ Summer pp 8 - 11
22. Heath M and Stott E (1990) Housing rabbits the unconventional way. *Animal Technology* 41 (1): 13 – 25
23. Held SDE, Turner RJ and Wootton RJ (1994) Effect of environmental enrichment on the behaviour of group-housed New Zealand White and Dutch x Californian laboratory rabbits. *Welfare and Science Proceedings of the 5<sup>th</sup> Symposium of the Federation of European Laboratory Animal Science Associations, Brighton 1993; Royal Society of Medicine Press* pp 358 – 360
24. Huls WL, Brooks DL and Bean-Knudsen D (1991) Response of adult New Zealand White rabbits to enrichment objects and paired housing. *Laboratory Animal Science* 41 (6): 609 - 612
25. Jezierski TA and Konecka AM (1996) Handling and rearing results in young rabbits. *Applied Animal Behaviour Science* 46: 243 - 250
26. Kalagassy EB, Carbone LG and Houpt K (1999) Effect of castration on rabbits housed as littermate pairs. *Journal of Applied Animal Welfare Science* 2 (2): 111 - 121
27. Kamel MM, Myers LJ and Cummins KA Influence of dietary fibre on maternal behaviour in rabbits. *Veterinary Medical Journal Giza* 41 (3): 23 – 29
28. Kersten AMP, Meijsser FM and Metz JHM (1989) Effects of early handling on later open-field behaviour in rabbits. *Applied Animal Behaviour Science* 24: 157 - 167
29. Krohn TC, Ritskes-Hoiting AJ and Svendsen P (1999) The effects of feeding and housing on the behaviour of the laboratory rabbit. *Laboratory Animals* 33: 101 – 107
30. Lehmann M (1987) Interference of a restricted environment - as found in battery cages – with normal behaviour of young fattening rabbits. In: T Axilia (Editor) *Rabbit Production Systems Including Welfare. Official Publications of the European Communities, Luxembourg* pp 257 - 268
31. Lehmann M (1991) Social behaviour in young domestic rabbits under semi-natural conditions. *Applied Animal Behaviour Science* 32: 269 – 292
32. Lidfors L (1997) Behavioural effects of environmental enrichment for individually caged rabbits. *Applied Animal Behaviour Science* 52: 157 – 169
33. Love JA and Hammond K (1991) Group-Housing Rabbits. *Lab Animal* 20 (8): 37 - 43
34. Love JA (1994) Group Housing: Meeting the Physical and Social Needs of the Laboratory Rabbit. *Laboratory Animal Science* 44 (1): 5 – 11
- 34a Marr JM, Calhoun J and Mader JT (1993) A non-stressful alternative to gastric gavage for oral administration of antibiotics in rabbits. *Lab Animal* 22 (2): 47 - 49
35. McBride EA and Wickens SM (1997) The rabbit – an exotic pet with behaviour problems. *Proceedings of the First International Conference on Veterinary Behaviour Medicine: 197 - 203*

36. Morton D (1993) Enrichment techniques for rodents and rabbits. *Proceedings of a conference Rodents and Rabbits: Current Research Issues* pp 20 – 27
37. Morton DB, Jennings M, Batchelor GR et al (1993) Refinements in rabbit husbandry: second report of the BVAAWF / FRAME / RSPCA / UFAW joint working group on refinement. *Laboratory Animals* 27: 301 – 329
38. Mykytowycz R and Fullagar PJ (1973) Effect of social environment on reproduction in the rabbit, *Oryctolagus cuniculus* (L) *Journal of Reproductive Fertility, Suppl* 19: 503 - 522
39. Nayfield KC and Besch EL (1981) Comparative responses of rabbits and rats to elevated noise. *Laboratory Animal Science* 31 (4): 386 – 390
40. NHMRC (1997) Australian Code of Practice for the Care and Use of Animals for Scientific Purposes ISBN 0 642 27266 2 [www.health.gov.au/hfs/nhmrc/research/awc/code.htm](http://www.health.gov.au/hfs/nhmrc/research/awc/code.htm)
41. Knudtzon J (1984) Plasma levels of glucagon, insulin, glucose and free fatty acids in rabbits during laboratory handling procedures. *Z. Versuchstierkd* 26: 123
42. O'Donoghue PN (ed) (1993) The accommodation of laboratory animals in accordance with animal welfare requirements. *Proceedings of the International Workshop held at Bundesgesundheitsamt, Berlin, 17<sup>th</sup> – 19<sup>th</sup> May.*
43. Patton NM (1994) Colony husbandry. *The Biology of the Laboratory Rabbit 2<sup>nd</sup> Ed* Academic Press Chapter 2 pp 27 – 45
44. Podberscek AL, Blackshaw JK and Beattie AW (1991) The behaviour of group penned and individually caged laboratory rabbits. *Applied Animal Behaviour Science* 28: 353 - 363
45. Podberscek AL, Blackshaw JK and Beattie AW (1991) The effects of repeated handling by familiar and unfamiliar people on rabbits in individual cages and group pens. *Applied Animal Behaviour Science* 28: 365 – 373
46. Potgieter FJ and Wilke PI (1993) Laboratory animal bedding and nesting materials for rodents and lagomorphs: the South African situation. *Journal of the South African Veterinary Association* 64 (4): 144 - 148
47. Raje S and Stewart K (1997) Group housing for male New Zealand White rabbits. *Lab Animal* 26 (4): 36 – 38
48. Rose MA (1996) Laboratory animal behaviour management. *Animal Welfare Conference, Taipei, Taiwan*
49. Shomer NH, Peikert S and Terwilliger G ((2001) Enrichment toy trauma in a New Zealand White rabbit. *Laboratory Animal Science* 40 (1): 31 – 32
50. Stauffacher (1992) Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal Welfare* 1: 105 - 125
51. Turner RJ, Selby JI, Held DE et al (1992) Preferred substrates for penned rabbits. *Animal Technology* 43 (3): 185 – 192
52. Turner RJ, Held DE, Hirst JE et al (1997) An immunological assessment of group-housed rabbits. *Laboratory Animals* 31: 362 - 372
53. Verga M, Nelli A, Leone P and Carezzi C (1987) Behaviour and performances of rabbit does and young rabbits. *Commission of the European Communities - Agriculture - Rabbit Production Systems Including Welfare- A*

*seminar in the Community programme for the coordination of agricultural research, 6 – 7 November 1986 pp: 231 – 243*

- 53a. Walden NB (1990) The TG Hungerford Vade Mecum Series for Domestic Animals Series C Number 13 - Rabbits a compendium. *University of Sydney Post-Graduate Foundation in Veterinary Science*
54. Wemelsfelder F (1994) Animal boredom – a model of chronic suffering in captive animals and its consequences for environmental enrichment. *Humane Innovations and Alternatives* 8: 587 – 589
55. Whary M, Peper R, Borkowski G et al (1993) The effects of group housing on the research use of the laboratory rabbit. *Laboratory Animals* 27: 330 - 341
56. Zutphen LFM, Baumans V and Beynen AC (Eds) (1993) Principles of laboratory animal science. Elsevier Science pp 17, 34, 35, 40 - 44

## 11. Recommended Reading

Batchelor GR (1999) The laboratory rabbit. *UFAW Handbook on the Care and Management of Laboratory Animals 7<sup>th</sup> Edition* (Poole T Ed): p 395 - 408

Boers K, Gray G, Love L, Mahmutovic Z, McCormick S, Turcotte N and Zhang Y (2002) Comfortable quarters for rabbits in research institutions. *Comfortable Quarters for Laboratory Animals 9<sup>th</sup> Edition* (Reinhardt V and Reinhardt A Eds): pp 1 – 13  
([www.awionline.org/pubs/cq02/cqindex.html](http://www.awionline.org/pubs/cq02/cqindex.html))

Cheeke PR (1987) Rabbit feeding and nutrition. *Academic Press Inc Orlando*

Gunn-Dore D (1997) Comfortable quarters for laboratory rabbits. In: *Comfortable Quarters for Laboratory Animals, Eighth Edition Reinhardt V (ed) Animal Welfare Institute Washington: 46 – 54*  
([www.awionline.org/pubs/cq/five.pdf](http://www.awionline.org/pubs/cq/five.pdf))

Hargreaves AL (2000) Housing for Laboratory Rats, Mice, Guinea Pigs and Rabbits. ANZCCART pp 92 - 102

Lidfors L (1997) Behavioural effects of environmental enrichment for individually caged rabbits. *Applied Animal Behaviour Science* 52: 157 – 169

Love JA (1994) Group Housing: Meeting the Physical and Social Needs of the Laboratory Rabbit. *Laboratory Animal Science* Vol 44 (1): 5 – 11

Morton DB, Jennings M, Batchelor GR et al (1993b) Refinements in rabbit husbandry: second report of the BVAAWF / FRAME / RSPCA / UFAW joint working group on refinement. *Laboratory Animals* 27: 301 – 329  
([www.lal.org.uk/labam.htm](http://www.lal.org.uk/labam.htm))

Stauffacher (1992) Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal Welfare* 1: 105 – 125

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Document prepared by Lynette Chave, Senior Veterinary Officer, Animal Welfare Unit, NSW Agriculture.

Comments provided, during the development of this document, by A/Professor Margaret Rose, Professor Lesley Rogers, Mr Mark Lawrie, Ms Susie Velte, Dr Peter Johnson, Mr Greg Alpen, Mrs Anne Alpen, Mr Stephen Boys, Dr Sandra Eady, Professor David Morton, the University of Newcastle AEC, the Canadian Council on Animal Care, Dr Malcolm France and the Central Sydney Area Health Service AEC and Dr Birgit Drescher are gratefully acknowledged.