

## Comfortable Quarters for Rabbits in Research Institutions

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In the past, laboratory rabbits have usually been kept singly in small cages that provide neither social nor environmental enrichment, and frequently the cages have been too small to permit some normal behaviors such as sitting up on the hind legs, hopping, digging, and hiding. Stereotypical bar licking or chewing, pawing at the corners of the cage, psychogenic polydipsia, and excessive self-grooming - resulting in the development of trichobezoars - are frequently seen in such animals and are recognized as indicators of reduced well-being. Single-caged rabbits often look unhealthy and depressed, sitting in a hunched position for hours on end. The extreme boredom induces some animals to overeat, others to undereat, leading to obesity and severe weight loss, respectively (Gunn-Dore, 1997). In addition, there are serious clinical problems associated with the small cage. Degenerative changes of the lumbar spine and femoral head have been attributed to the lack of basic locomotor activity in the small, conventional cages (Wieser, 1986). It is questionable if statistically reliable and scientifically meaningful research data can be obtained from animals kept under such inadequate housing conditions.

There have been several reports of improved housing for laboratory rabbits and most have a base in the behavior of the wild European rabbit (*Oryctolagus cuniculus*; Morton et al., 1993; Love, 1994; Wemelsfelder, 1994; Gunn-Dore, 1997). Detailed descriptions of this behavior are available from the study of rabbits in their natural environment and in semi-wild conditions (Mykytowycz, 1958; Kraft, 1978; Lehmann, 1991). While it is usually impossible to accommodate all behaviors seen in the wild, at least basic behavioral needs can readily be addressed in the laboratory setting.

Wild rabbits are social animals who interact with each other whether they live in large groups or small groups. Aggression among females is limited although dominance hierarchies are formed, and females with young will chase other rabbits away from their nests. Aggression among males increases as they approach puberty and consists mainly of chasing, with one rabbit trying to get out of the sight of the other. Amicable interactions (e.g., mutual grooming, lying close together) are usually seen only in the sexual context between a buck and a doe. Female/female amicable interactions occur under laboratory conditions in the absence of males. Both sexes may participate in scent marking of inanimate objects. Young rabbits sport and play with each other and with inanimate objects. In the wild, rabbits dig burrows to hide and nest in, and they dig for the roots of plants. In the laboratory, rabbits will dig for no obvious reason, indicating that they are highly motivated to engage in this activity.

This very brief review of the rabbit's species-typical behavior provides us with some indicators for the development of comfortable housing. We are usually restricted by the available space and by some experimental limitations. Pregnancies are undesirable, except in the breeding colony. Mature males and females can, therefore, not be kept together.

The most suitable quarters for rabbits allow for social interaction and provide physical substrate for digging, playing and hiding. Several authors have described housing systems that provide these needs, both for breeding colonies and experimental animals. There have also been descriptions of short-term single-housing systems that attempt to address as many of the needs as possible.

### The rabbit pen

Rabbits are gregarious animals and, therefore, should be housed in compatible groups (Stauffacher et al., 1994). Each rabbit is provided with substantially more living space and hence has much better opportunities for exercising in a group-pen than in a single-cage. ***The quality of life of group-housed rabbits is significantly improved***, even of individuals who rank low in the social hierarchy, compared to those kept in solitary confinement (Held, 1996; Batchelor, 1999). Group members spend an average of 79% of the time in close proximity with others (Gunn and Morton, 1993). Behavioral disorders, which typically occur in single-caged rabbits, are virtually absent in group-housed rabbits (Loeffler et al., 1991; Podberscek et al., 1991; Love, 1994; Krohn et al., 1999; Held et al., 2001). Compatible group-housing does not significantly affect stress-sensitive variables and infectious disease susceptibility (Love and Hammond, 1991; Gunn-Dore, 1997; Turner et al., 1997).

***Female rabbits are generally compatible with each other.*** Given a choice, they prefer to be in the company of another doe than living alone (Brooks et al., 1993). Housing female rabbits in pairs or groups not only allows them to express their social needs, but it also makes them less susceptible to stress than single-caged does. The company of other rabbits has an emotionally protective effect during stressful situations.

***Male rabbits develop a biological intolerance of other males when reaching sexual maturity*** at the age of 12-14 weeks. Young males can and should be housed in a social setting until that time, but they have to be separated from other males thereafter to prevent injuries resulting from fighting. Castration prior to puberty can resolve this problem (Love and Hammond, 1991). Single-housed bucks should not live in social isolation but they should be able to see and possibly touch and smell other rabbits without being able to engage in fighting.

Rabbits, like all social animals, develop dominance-subordination relationships that are a prerequisite for a harmonious group life. Removing or replacing an adult group member inevitably disrupts these relationships and may lead to serious aggressive disputes. ***It is very important to keep the composition of a group stable.*** Individual animals who have to be temporarily separated for experimental or clinical reasons should always be housed in such a way that they can maintain visual contact with the group. This ensures that they will be readily recognized and accepted as familiar members of the group upon returning. It is often said that a rabbit who has undergone a surgical procedure should be isolated so that other rabbits don't abuse him or her and nibble at the sutures. We have found that this rarely occurs. It is our experience that rabbits lie down beside a group member who is returning from a surgery, and that this extra warmth and comfort hastens the recovery process.



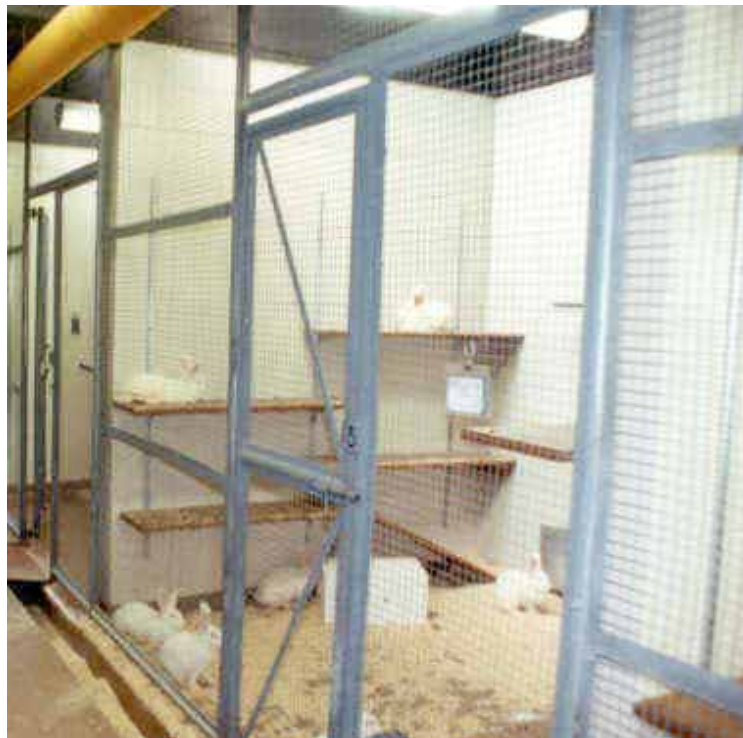
**Figure 1. Rabbits have a preference for straw as bedding (Photo by Debbie Gunn-Dore).**

The primary enclosure of a rabbit group should be large enough to allow three hops in one direction. A fully grown New Zealand White rabbit will move forward 1.5 to 2.0 m in three such hops (Love, 1994). **Hence, the pen should measure at least 2 m in one direction.** If more than two adult rabbits of the weight category 4-6 kg are housed together, the minimum floor area of the primary enclosure should be 2 m<sup>2</sup> for up to four animals, increasing by 0.45 m<sup>2</sup> for each additional adult rabbit (Gunn-Dore, 1997). The height of the pen should be not less than 1.20 m to prevent the rabbits from leaping out. If a wire mesh cover is used to keep the animals in, it must be at least 75 cm above the floor to allow adult rabbits to sit in the lookout posture.



**Figure 2. The resting boards of the converted dog runs provide a comfortable place for the rabbits to sit on and to hide under.**

The rabbit pen should be provisioned with woodchip litter or preferentially with *shredded paper or straw* bedding (Figure 1). When given the choice, rabbits prefer straw or shredded paper and avoid sawdust or wood shavings (Turner et al., 1992). *Hay* must be provided for foraging and nest-building. There must be nest boxes for breeding females, designed in such a way that they make it impossible for littering does to see each other and trigger infanticide behavior. *Shelves* should make the vertical dimension accessible and offer comfortable resting and refuge places (Figure 2 & 3). *Wooden sticks* and tree branches are suitable to promote gnawing behavior. Rabbits will spend about 20% of the time gnawing such objects (Stauffer, 1992). Cardboard boxes, plastic crates and/or sections of 18-inch PVC pipe should be available as substitute *burrows* and "safe" places to retreat in fear provoking situations or during social conflicts. At least one wall of the enclosure should consist of wire mesh so that the animals can overlook their surroundings and see approaching personnel (Figures 1 & 3).



**Figure 3. Rabbits make use of shelves to access the vertical dimension of their pen.**

The rabbits at our facility are housed in pens that were originally designed for dogs (cf., Tamburrino et al., 1999; Figure 2 & 4). Each pen holds six to eight animals. There is an indoor section with a resting board and an outdoor section. The rabbits move freely from one area to the other. The indoor section measures approximately 1.5 x 1.7 m, the outside section 3.5 x 1.7 m. We have noted that our rabbits like to explore and that they do not mind climbing. They often sit on the resting boards (Figure 2) and when given the opportunity, will climb much higher and seem quite relaxed about it (Figure 3). The outdoor run allows the rabbits to indulge in "fast running," an activity which we frequently observe, particularly in young animals. A rabbit runs quickly to one end of the pen, stops and then runs quickly to

the other. This may be repeated several times. We have never observed a special reason for this exercise, other than that the animals obviously enjoy it.



Figure 4. Rabbits relaxing in their indoor-outdoor pen.

### Establishing a new group of rabbits

Group sizes of four to eight adult rabbits work well if the groups are to remain together for a long time. Larger groups of subadult rabbits may be maintained for short periods of time. It is good advice to establish a new group with *young animals* who have not reached puberty. Group members should be of the same age and sex, but it is not necessary that they are littermates.

Group-housing rabbits who have been previously single-caged for more than six months is not recommended. Such animals will be extremely fearful, will lack proper motor coordination resulting from long-term hypoactivity and will be prone to injuries and fractures due to weakness in the bone structure (Drescher and Loeffler, 1991; Rothfritz et al., 1992; Gunn-Dore, 1997). *Pair-housing* them in double-cages minimizes these risks while offering a more species-adequate, social environment (Bigler and Oester, 1994). Pair-housing is recommended for immature rabbits, adult females and castrated males (Huls et al., 1991; Stauffacher, 1992; Bigler and Oester, 1994; Raje and Stewart, 1997). Mature bucks cannot be kept in pairs because of the serious risk of injurious aggression.

### The rabbit cage

Under *exceptional circumstances* - such as research studies requiring urine collection - a rabbit may have to be single-housed for a limited period of time. Provision must be made that such an individual animal is not visually isolated from other rabbits and that his or her cage is sufficiently sized to allow normal postural adjustments with freedom of movement (United States Department of Agriculture, 1991) and is adequately enriched to relieve

boredom.

An adult rabbit is about 75 cm tall when sitting in the rabbit-typical lookout posture (Figure 5) and approximately 80 cm long when resting in rabbit-typical lateral sternal recumbency (Figure 6). ***The primary enclosure of single-housed animals should, therefore be at least 75 cm high and no less than 80 cm long.*** It should be 68 cm wide to allow the animal to comfortably turn around and change postures (Gunn-Dore, 1997).

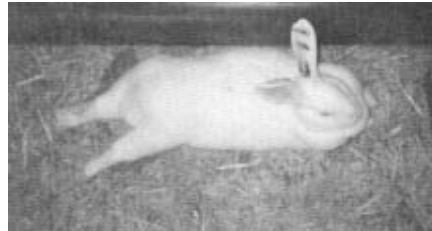


Figure 5 (left). An adult rabbit is about 75 cm tall when sitting in the rabbit-typical lookout position (Photo by Debbie Gunn-Dore). Figure 6 (above). An adult rabbit is approximately 80 cm long when resting in typical rabbit-fashion (Photo by Debbie Gunn-Dore).

Each cage should be provisioned daily with high-quality *hay* to promote the expression of foraging, playing, investigating and nesting behavior. The hay should be placed on the top of the cage so that the animal can spend some extra time retrieving it through the bars. There should also be at least one **wooden stick** [length approximately 10 cm; diameter approximately 2.5 cm] or other rabbit-suitable enrichment gadgets, such as brass wire balls triggering species-typical gnawing, chin-marking and playing (Huls et al., 1991; Gunn-Dore, 1999). Gnawing sticks have been used for a 2-year test period as effective enrichment objects for single- and pair-housed rabbits without noticeable hygiene and health problems (Brooks et al., 1993). It is a general idea at some facilities that rabbits need gnawing sticks to prevent their teeth from getting too long (Lindfors, 1997).

Single-caged rabbits who have access to hay and other enrichment objects show a reduction in stereotypical behaviors and a marked increase in their overall activity, relative to animals kept in barren cages (Gunn-Dore, 1997; Berthelsen and Hansen, 1999). Hay has proven to be particularly effective in reducing behavioral disorders and giving individually housed bucks something to do (Lindfors, 1997). The single-housed rabbit also needs a 'safe' refuge to hide in alarming situations. A section of a PVC tube can serve as a substitute **burrow** meeting this requirement.

Cages should be designed in such a way that the rabbits are not restricted to grid or wire flooring - which is uncomfortable for the animals and very often results in sore hocks [ulcerative pododermatitis] (Kraus and Weisbroth, 1994) - but that they also have access to a **raised solid-floor area**. This raised area offers a choice of resting sites, light gradients and a stimulus for exercise (Stauffacher, 1993; Gerson, 2000). The cages should be arranged at waist-height for easy access and cleaning. Multi-tier caging systems are not recommended

because they do not allow the provision of uniformly distributed illumination (United States Department of Agriculture, 1991), a prerequisite to avoid variability of research data resulting from variable illumination in the cages (Bellhorn, 1980; Clough, 1982).

### **The animal care technician's role in providing a stress-free environment for rabbits**

Although comfortable housing is important for the rabbits, much of the effort would be wasted if the other activities surrounding the rabbits were not also comfortable and non-stressful. In this respect, the animal care technician plays a vital role. The following are examples where technician/rabbit interactions are important.

Group-housed rabbits must be caught with a minimum of chasing. We can make use of the rabbit's natural tendency to hide when startled. In our case, the rabbits duck under the resting board (Figure 2) where they may be identified, picked up and handled in a gentle and skillful manner. Any dark hiding place will serve the same purpose, but a quiet, smooth approach is required. *It is important not to startle the animal in his or her hiding place.* Once the animals are used to being picked up, they may not even hide from a technician they know well. The anticipation of what is to happen after being caught plays a major role in the rabbit's behavior. Procedures carried out with the rabbits should be as free of stress as possible. Rabbits who are used to being treated with compassion and professional skill will not panic in anticipation of procedures (Figure 7). Carefully bundling a rabbit in a blanket and gently covering his or her eyes with a towel usually has a calming effect, even on a very agitated animal.



**Figure 7. Unsedated rabbits waiting to have blood samples taken. The rabbits are accustomed to travelling to and from their pens on these carts.**

***The traditional rabbit restrainer for taking blood samples is unnecessary if you provide good analgesia and some gentle handling.*** Blood sampling is least stressful if the subject is

given a sedative and an analgesic. The added advantage is that the arteries and veins are dilated, making it easier to take the samples. Local anesthetics [e.g., EMLA cream] may serve the same purpose.

***Rabbits have the potential of learning to cooperate rather than resist during procedures.*** It has been documented that they can easily be trained to cooperate during oral drug application, thereby avoiding the stressful gastric intubation procedure. The animals would stand with their paws on the front of the cages, protrude their faces from between the bars, and appear to beg for the sucrose-coated tip of the syringe containing the drug (Marr et al., 1993).



**Figure 8. Regular, gentle health checks weighing are important in monitoring the well-being of the rabbits and fostering a positive human-animal relationship.**

It is important that illness be recognized early in laboratory rabbits. This can be crucial because pre-emptive treatment for diseases like coccidiosis is often contraindicated. As a prey species, rabbits will disguise any signs of illness if they can. A reduction of food intake may be an early sign. It is useful to weigh the rabbits whenever they are handled, for example when blood samples are being taken (Figure 8). This allows early detection of inappetence. In addition, small quantities of treats, such as carrots, lettuce or leafy hay, may be used to check if the rabbits are still eating (Figure 9). Normally all members of the group will gather round the treat. A rabbit who hangs back may not be feeling well and should be looked at a little more closely. Personnel who regularly distribute treats are recognized by the rabbits who will often gather at the front of the pens at the sound of the treats bag. This is an elegant way to check all members of the group, a task that should be done at least once every day. Technicians quickly learn to notice subtle changes in behavior and so become aware of health problems. Special work time should be set aside for them so that they can



pat their charges every day, thereby fostering a positive human-animal relationship (Home Office, 1989). *The gentle touch provided by the technicians is as important as the physical environment in giving the rabbits a sense of security* in the presence of humans who, in other circumstances may subject them to uncomfortable, perhaps even painful procedures. Gentle, frequent handling of rabbits buffers their fear response during stressful situations (Anderson et al., 1972; Kertsen et al., 1989). Rabbits who receive special attention from personnel [frequent handling, petting, playing, gentle vocalization] show a markedly increased resistance to certain pathological processes than subjects who receive no extra attention (Nerem et al., 1980).



**Figure 9. Providing treats helps win the confidence and trust of the rabbits and allows the technician to check their appetite.**

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