No data are available on transport mortality rates in rabbits, but information obtained from commercial practices suggests that mortality rates of between 0.1% and 0.4% occurred when the pre-slaughter fasting period was longer than 12hours (Leoni et al., 2000). Cases of post-transport mortality rates of 7 and 8% have also been reported, particularly if the vehicle was not provided with a controlled air ventilation system. This mortality can rise dramatically when unexpected long stops occur during the journey, e.g. traffic jams. Elevated ambient temperatures and high humidity rates can increase losses even further. Under-graded carcasses represent about 1% and are due to trauma or broken bones. Ferrari et al. (1989) observed a high incidence of traumatic lesions, characterised by subcutaneous haemorrhages caused by loading and unloading for transport. These lesions were mainly leg fractures and bruising which reduced meat gradings (Leoni et al., 2000).

13. TRANSPORT OF DOGS AND CATS

13.1. Introduction

Transport may be stressful for dogs and cats (MacArthur, 1987; Leadon and Mullins, 1991). However, there is much less information available on the effects of transport conditions on the welfare of dogs and cats than on many other domestic species, particularly farm animals. Further, much of the available information is in the form of recommendations based on practical experience, rather than on controlled experiments. This distinction between practical recommendations and scientific evidence will be made clear whenever possible in this report.

This report focuses on (1) individual differences in responses to transport in dogs and cats, (2) space allowance when animals are transported individually, (3) transport of several animals together, (4) recommendations other than size on the containers used to transport dogs and cats, (4) feeding and watering frequency, (5) animals unsuitable for transport, and (6) inspection.

13.2. Individual differences in response to transport

Individual dogs and cats may differ greatly in their response to stressors and it is likely that this applies to the stress of transport as well. Although part of this individual variability is probably due to genetic factors, habituation, rearing conditions also play a role. There are at least three important issues to consider:

a. There is a “socialization period “ in puppies that is very important for the formation of primary social attachments. This period extends for 2-3 to 9-13 weeks of age (Scott, 1962; Scott and Fuller, 1965). This period is relevant here because it is recommended that the puppy should be introduced during the socialization period to the stimuli that it is likely to encounter as adult (Scott and Fuller, 1965), so that it becomes easily habituated to them. Thus, exposing the puppy to the container used for transport before the end of the socialization period may be useful. A similar period has been described in cats and it extends from 2 to 7 weeks of age (Karsh and Turner, 1988).

b. Early handling of puppies and kittens may have beneficial effects on their response to stressors later on in life. Canine neonates exposed to varied stimulation from birth to five weeks of age were found to be more confident when tested later in strange situations than non-stimulated animals (Fox, 1978). Similarly, kittens which were handled for five minutes per day from birth to 45 days of age approached strange objects more readily than controls (Wilson et al., 1965). Thus, although no studies have been done on the effects of early handling on the stress of transport, it seems likely that it may have a beneficial effect.

c. Habituation helps in the management of potentially stressful events in animals and habituating dogs and cats to transport conditions may be useful (Leadon and Mullins, 1991). IATA (2002) recommends that dogs and cats are habituated to the container that will be used for air transport well in advance of the journey. Similarly, habituation to humans is important to avoid fear reactions during transport and handling. Some dogs may benefit from the presence of the owner as this can decrease fear and stress.

13.3. Space allowance when animals are transported individually

Dogs and cats are usually transported in specially designed containers, either individually or –less frequently- in groups. Dogs may also travel loose in small groups in the cargo area of a suitable vehicle (LABA and LASA, 1993)

Individually transported dogs

As it is generally recommended that the container used to transport dogs should be large enough to permit the animal to lie down (see below), it might be useful to know the resting postures adopted by dogs. Dogs may lie down in four different postures (Beaver, 1999): sternal recumbency, lateral recumbency, a combination of cranial sternal recumbency and caudal lateral recumbency, and on their back. When dogs lie in lateral recumbency, legs may be fully extended and the area occupied by the dog will then be equivalent to its length multiplied by at least its height from floor to withers. According to Beaver (1999), lateral recumbency may account for up to 26% of the total lying time, sternal recumbency for up to 20% and the combination of lateral and sternal recumbency for up to 53%.

Recommendations by other bodies are that the container should be large enough to permit the animal to stand in a natural position, turn around and lie down (LABA and LASA, 1993; AATA, 2000).

In several of the available set of recommendations, the size of the container is based on three measurements:

- Height of the animal (H) (from floor to top of the head)
- Length of the animal (L) (from nose to root of the tail)
- Width of the animal (W) (measurement through the shoulders)
- Length of legs (B) (from floor to elbow joint)

The recommended size of the container is then:

- Length = L + 20 cm (AATA, 200) or L + ½ B (LABA and LASA, 1993)
- Height = H + 5 cm (AATA, 2000) or H (LABA and LASA, 1993)
- Width = W x 2 (LABA and LASA, 1993; AATA, 2000)

The main difference between the two sets of recommendations refers to the height of the container. Although we are not aware of any experimental work addressing this issue, the recommendation of AATA will probably allow for better ventilation. A second issue is that in some cases, none of the above recommendations would allow the dog to lie down in lateral recumbency, as the container should then be wider. This may be relevant because as explained above lateral recumbency accounts for a considerable proportion of the total resting time. However, to the best of our knowledge there is no study on the effects that being prevented from adopting this posture may have on the dog's welfare. Finally, AATA recommendations on extra space (20 cm in length or 5 cm in height) do not take into account differences between dogs in body size. It would be better, therefore, to relate this extra space to the size of the dog. The above recommendations refer to laboratory dogs, i.e. mainly Beagles, that measure between 30-40 cm in height (from floor to the withers, which would be equivalent to some 60 cm from floor to top of the head) and some 60 cm in length (from nose to the root of the tail). Therefore, the recommended space is roughly equivalent to L + 30% and H + 10%.

Individually transported cats

As it is generally recommended that the container used to transport cats should be large enough to permit the animal to lie down (see below), it might be useful to know the resting postures adopted by cats. According to Beaver (1992) there are three basic body postures associated with lying. Sternal recumbency is one of them; the forepaws may be pointed forward or rotated and flexed so that they are tucked back under the cat. A second posture is complete lateral recumbency with the cat either stretched out or curled with the paws folded around one another. Lateral recumbency is associated with sleep; cats may sleep for up to 9-12 hours a day, *i.e.* 40-50% of the total time (Beaver 1992). The posture adopted when in lateral recumbency is affected by ambient temperature and the warmer the environment, the more stretched out is the posture adopted by the cat. The third lying posture is a combination of cranial sternal recumbency and caudal lateral recumbency.

Recommendations given by other bodies are that the container should be large enough to permit the animal to stand in a natural position, turn around and lie down (LABA and LASA, 1993; AATA, 2000). LABA and LASA (1993) recommend containers 52 cm long x 35 cm wide x 35 cm high (in the case of rectangular containers) and 50 cm diameter x 35 cm high (in the case of circular tubs). Hurni and Rossbach (1987) recommend containers of 61-68 cm long x 36-44 cm wide x 40 cm high. AATA (2000) recommends working out the size of the container using the same method as in the case of dogs.

The above recommendations can be divided into two groups: those that take into account the actual size of the cat (AATA, 2000) and those that do not (LABA and LASA, 1993; Hurni and Rossbach, 1987). The obvious problem with the latter is that cats may differ in size. Although the diversity of body size is much less in cats than in dogs, there may still be a large variation. For example, adult, non castrated males may weigh between 3.5 and 7 Kg –and in some cases even more-, depending on body condition and breed, among other things. In principle, then, AATA's recommendations would appear better. Nevertheless, the problem already mentioned for dogs will also occur with these recommendations, as some cats might be prevented from lying down in lateral recumbency with fully extended legs. This might occur, for example, with thin, slender breeds such as the Siamese. Again, to the best of our knowledge, there is no study on the possible effects that this might have on the welfare of the animal.

13.4. Transport of several animals together

Recommendations given by other bodies are that dogs and cats may travel in group only if (1) they are familiar with each other and do not show aggressive behaviour, (2) females are not in oestrus, and (3) none is over 14 Kg bodyweight (AATA, 2000). Following the Animal Welfare Act of the United States Department of Agriculture, IATA (2002) states that only dogs and cats less than 6 months of age, weighing less than 9 Kg and having a comparable body size can be placed together in the same container for air transport, even if the animals are familiar to each other. The reason for this is that even acquainted animals may become stressed and aggressive when travelling by air (IATA, 2002).

According to LABA and LASA (1993), a maximum of 2 adult dogs of comparable size up to 14 Kg each that are compatible with each other may be shipped in the same container. Animals over that weight must travel individually. Animals up to 6 months old from the same litter and up to a maximum quantity of 3 animals may be shipped in the same container. The length and height of the container are determined in the same way as for a single animal, considering the largest animal. The width of the container should be W x 3 (2 animals) and W x 4 (3 animals).

According to Martin (1998), one cat per container is permitted for air travel and up to 4 compatible cats per container are permitted for ground transportation, but no information is available on the size of containers for more than one cat. Hurni and Rossbach (1987) state that containers of the recommended size (see above) can accommodate 1 or 2 cats, that should be of the same breeding group to avoid fighting.

It is well known than dogs and cats may be aggressive towards unfamiliar conspecifics. It seems therefore reasonable that unfamiliar individuals should not be transported together. The problem, however, is whether transporting familiar animals together can be recommended. One problem that must be considered is redirected aggression. A redirected behaviour is a motor pattern appropriate for a motivational state that is directed to an irrelevant but accessible target because the primary target or stimulus is inaccessible

(Bastock et al., 1953). Redirected aggression is common in animals and seems to be particularly frequent in cats (Chapman and Voith, 1990). A common situation that may elicit redirected aggression is when a cat is aroused because it is afraid and reacts aggressively towards another cat that is nearby (Borchelt and Voith, 1982). As it is likely that transport may be frightening, redirected aggression may occur even between well acquainted individuals. Therefore, particularly when animals may not be frequently inspected during the journey – as it may be the case, for example, during air transport, it is preferable not to transport several animals together in the same container, with the exception of young dogs and cats.

13.5. Qualities needed for the containers used to transport dogs and cats

Containers used to transport dogs and cats should safely and securely contain the animal or animals. The inside of the container must be free of any projection or object that could injure the animal. Animals must not be able to push parts of their bodies through the sides of the container. Containers should be clearly marked "LIVE ANIMALS" and it should be indicated which side must face up. Also, each container must be clearly marked with the type and number of animals in it, and the consignor's and consignee's name, address and telephone. All containers must be secured to the vehicle (Hannah, 1998; LABA and LASA, 1993; AATA, 2000). Bedding should be provided (Hurni and Rossbach, 1987; AATA, 2000)

According to AATA recommendations (AATA, 2000), containers should be loaded in such a way that there is at least 10 cm space between each crate for ventilation. Dog containers should not be stacked more than two high, and cat containers not more than three high. Containers should be mounted on pallets to raise them from the floor. Antagonistic animals should be loaded in such a way that they can not see each other.

It has been mentioned that one difficulty with the size of the container may occur during air transport, when animals are transported in the below-floor cargo section of passenger carrying airlines. The dimensions of the door of this section may prevent the use of containers taller than 86.5 cm (for example in Boeing 737 aircraft) which is less than the height of some dogs (Leadon and Mullins, 1991). It is not clear whether this may cause stress in the animals.

Thermoregulation problems appear to be important welfare problems in the transport of dogs (Laedon and Mullis, 1991) and possibly cats (Martin, 1998). At least in this latter species, cages made from highly insulating plastic material should be avoided, as they can cause overheating (Hurni and Rossbach, 1987).Although there is very little information on the range of acceptable temperatures for dogs and cats, it is accepted that adequate ventilation is important for the welfare of both species. The ventilation system should provide fresh air with minimal drafts (Martin, 1998). For dogs, ventilation is adequate if one whole side of the container be open and consist of bars or wire mesh. In addition, ventilation openings of 2.5 cm over the whole surface of the opposite side at a distance of 10 cm from centre to centre of each opening are needed with similar openings on the upper third of the remaining two sides. The total ventilated area needed a minimum of 16% of the total surface area of the 4 sides (LABA and LASA 1993; AATA, 2000). Similar recommendations are given for cats; Hurni and Rossbach (1987) advise that the total ventilation area

should occupy 10-15% of the area of the side. It is important to remember that animals must not be able to push parts of their bodies through the sides of the container. In the case of dogs, different breeds may differ in their susceptibility to heat stress and transport of animals such as boxers, bulldogs and Pekinese when ambient temperatures are high may not be safe, as dogs with snub nose have difficulty in maintaining a normal body temperature in hot weather (IATA, 2002).

13.6. Feeding and watering frequency

According to Mugford (1977), dogs that have free access to food 24 hours a day eat many small meals a day. Rashotte at al. (1984) found that Beagles living in individual kennels with dry food freely available eat at dawn, at dusk and whenever fresh food is offered. This suggests that feeding only once a day is not preferred by dogs.

It is widely accepted that all breeds of dogs descend from the wolf (*Canis lupus*) (see Lindsay, 2000 for a review). Wolves digest food quickly and eat several times a day when large amounts of food are available. On the other hand, however, it is not uncommon for wolves to have to go without food for several days at a time and wolves seem to be well adapted to fasting (Mech, 1970).

Cats eat many small meals per day when food is freely available. This is not surprising considering that that small rodents are the natural prey of cats and that wild or feral cats may kill and eat many mice per day (Houpt, 1991).

The metabolic effects of fasting have been studied in dogs by de Bruijne and Koster (1983). Maximal depletion of liver glycogen occurred between the second and the third day of fasting and starvation-induced glycogenolysis was much slower in the dog than in men and rats. The authors concluded than in the fasting dog larger amounts of glycerol are available for gluconeogenesis than in other species. This may suggests that dogs are more resistant to fasting than other species.

Recommendations given by other bodies are that adult dogs and cats should be fed at intervals of not more than 24 hours (MacArthur, 1987; LABA and LASA, 1993; Martin, 1998; AATA, 2000). Water should be provided every 12 hours (MacArthur, 1987; LABA and LASA, 1993; Martin, 1998; AATA, 2000). Water can be provided in spill-proof containers for long journeys (MacArthur, 1987; AATA, 2000) or the vehicle should be stopped to offer water to the animals. In this case, the animals should be allowed sufficient time to drink; LABA and LASA (1993) recommend 30 minutes for dogs and cats, whereas Martin (1998) recommends 1 hour for drinking twice a day for cats.

Young animals more often, puppies and kittens less than 16 weeks of age at least every 12 hours need food according to Hannah (1998). MacArthur (1987) recommends that “young” dogs are fed every 8 hours. According to AATA (2000), animals under the age of 6 weeks should be allowed to suckle at intervals of not more than 4 hours (see below).

Dogs and cats are prone to travel sickness and vomiting. LABA and LASA (1993) therefore recommend that the animals are fed a light meal 4 hours before commencing the journey and should be exercised immediately before

dispatch to stimulate elimination. AATA (2000) recommends that the animals are not fed for 2 hours prior to dispatch. IATA (2002) advises reducing the quantity of food given to the dog or cat the day before an air transport, leaving water available not taking dogs for a walk before being shipped so that they are allowed to urinate and defecate. A light meal before tendering the animal to a carrier may have a calming effect.

Although it is difficult to critically assess the LABA, LASA and AATA recommendations, it may be concluded that although feeding once every 24 hours is not preferred by dogs, they are relatively well adapted to fasting. One point that should be kept in mind, however, is that dogs differ greatly in body size and small dogs may not be as resistant to fasting as medium or large dogs. Other factors such as body condition, degree of insulation, feeding before transport, and handling before and during transport may also modify the animals' response to fasting and this should be taken into account. In cats, there is even less information available.

13.7. Transport of young animals, inspection and use of drugs

Young animals under the age of 6 weeks are not generally suitable for transport. If left with their mother there is a risk of accidental suffocation . However, they need to suckle at frequent intervals (see above) (AATA, 2000). Inspection every 4 hours, when temperature, ventilation and general condition of the animals can be checked is important (Hannah, 1998; Martin, 1998). Using drugs when animals are transported by air may be dangerous, as drugs may act differently at the pressure in the cabin and cargo area (IATA, 2002).

14. TRANSPORT OF RODENTS AND PRIMATES

Several of the species which are used in laboratories are mentioned in other chapters of this report, for example rabbits, dogs and cats. However, rodents are not discussed elsewhere so will be considered briefly here.

Primates might be transported for various reasons, especially because they are used in laboratories. A short section from the SCAHAW Report on the welfare of captive primates is reproduced here.

Despite the fact that large numbers of laboratory animals are transported, largely from supply companies to the laboratories where the animals will be used, very few scientific studies provide data of any kind on the effects of transport on laboratory animal welfare. The material presented here is largely derived from guidelines produced as a result of practical experience so less reliance can be placed upon it than on data from scientific research.

14.1. Rodents

The transport of laboratory rodents, particularly the species listed below, is based on practical experience of moving probably millions of animals over several decades. The species about which there is most practical experience are laboratory rats (*Rattus norvegicus)* and mice *(Mus musculus).* Other rodents are also transported include the guinea-pig (*Cavia porcellus),* the golden

hamster (*Mesocricetus auratus)*, and the Mongolian gerbil (*Meriones unguiculatus)*. All of these are quite small or very small mammals, hence they can be transported in cages and other sorts of boxes. These boxes are designed so that gnawing animals cannot escape and are provided with ports that permit ventilation and inspection. The box construction material and the bedding material are non-toxic and non-consumable. Some of the containers are washable, autoclavable and re-usable. With the exception of hamsters that do not normally live in social groups, and male mice of some strains, animals are often transported in breeding pairs or in groups that are familiar with each other. Extreme care should be taken when placing animals in boxes, as well as removing them so that if animals escape they can be easily caught, for example in a garbage bin or hood. Several groups can be transported in one cage or box through the use of cage dividers.

Food and water are supplied as may of these small species require constant access to feed to maintain their body temperature. Food for rodents during transport is normally in the form of dried pellets or in some cases fresh vegetables and fruit (e.g. apples, carrots, potatoes) and, provided that the animals have had experience of such food, these diets are adequate. Food that is likely to decay over a short time should be avoided. Water is commonly provided sometimes provided from agar or as colloidal "gelled water".

Rodents require sufficient space to be able to adopt a comfortable resting position, to groom, to rear up, and to move in general. The stocking densities recommended by the Laboratory Animal Science Association for rodent species given below are based on practical experience. Mortalities can occur from fighting when unfamiliar animals are shipped, or they have been diverted during a flight and kept in inappropriate places at airports. There are different recommendations on stocking densities for filter top transport boxes and those where the circulation is not impeded.

Since welfare during transport will be poor if animals give birth during the journey, it is necessary to know the date of onset of pregnancy and the gestation period, so that the last five days of pregnancy can be avoided (see Table 14.1.1.).

It may be necessary to change some aspects of transport if genetically modified animals or genetic mutants with different needs are transported, for example some mutants are hairless.

Table 14.1.1. Typical gestation periods and latest day for transport .

Species	Gestation period	Last day for transport
Cat	64-67	42
Dog	61-65	40
Guinea pig	56-75	45