

STRESS AND ADAPTATION OF CATS (*FELIS SILVESTRIS CATUS*) HOUSED SINGLY, IN PAIRS AND IN GROUPS IN BOARDING CATTERIES

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Abstract

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For cats, appropriate housing conditions and a quick adjustment to new surroundings should be promoted during temporary stays in animal shelters and boarding catteries. In this study the development of stress in 140 boarding cats during a two-week stay under single-, pair- and group-housing conditions in a boarding cattery was investigated and compared with the stress levels of 45 control cats which had been at the animal shelter for several weeks. Signs of stress were recorded by a non-invasive Cat-Stress-Score.

Overall, the levels of stress in boarding cats declined during the two weeks of boarding, with a pronounced decline in the first days, but did not reach the stress levels of the control group by the end of the second week of housing. In the second week, the average stress level of about one third of all boarding cats was rated higher than 'weakly tense' with 4 per cent of cats rated even higher than 'very tense'. Neither housing style (single, paired or grouped) nor age had an influence on stress levels.

It was concluded that about two thirds of the boarding cats adjusted well to the boarding cattery during a two-week stay, while for the other third, temporary boarding was more stressful. For 4 per cent of the animals the two-week stay in a boarding cattery was classified as inappropriate because no reduction of their high stress levels occurred.

Keywords: *animal husbandry, animal shelter, animal welfare, boarding cattery, cat, stress*

Introduction

An important goal of animal welfare, legislation and of many animal owners is to ensure appropriate housing conditions for pets in their homes as well as during temporary housing in shelters and catteries.

Welfare can be defined as a state of an individual animal in regard to its attempts to cope with its environment (Broom 1988). When conditions become difficult in their natural environment, animals develop mechanisms to cope with problems they are likely to encounter, eg extreme temperature or attack by predators. However, these coping mechanisms can become ineffective when animals are faced with man-made changes in the

environment. When coping mechanisms are overtaxed, animals become stressed and welfare problems arise (Bradshaw 1992).

The spatially and socially different environment at an animal shelter or boarding cattery provides a situation that could lead to stress (Bradshaw 1992; McCune 1992; Turner 1995). However, stress symptoms may gradually disappear as the cat adjusts to the new environment. Whether an adjustment takes place and how it proceeds depends upon the housing conditions (Smith *et al* 1990; Roy 1992), the character of the animal and any previous experience which the animal has had with shelters (McCune 1992, 1994). In any case, the duration of stay has to be long enough to allow the required adjustment to occur.

Smith *et al* (1990) studied the adjustment of group-housed cats to indoor cages which had a floor area of 5m². Some behavioural indicators of stress, eg vocalization and escape behaviour decreased rapidly after the first four days. Other indicators, such as aggressive behaviour and the time animals spent underneath objects, showed a more gradual decline over time. The authors concluded that social contact between the animals of a group negatively affects stress in the first phase of the stay, but helps diminish stress symptoms during a longer stay of several months.

McCune (1992) used a Cat-Assessment-Score to study the stress reaction of cats in single cages (1.0x0.5x0.5m) during the first 24 hours in an animal shelter. The most pronounced decrease in stress levels was found during the first 10 minutes and between the first and second hour after placing the cat into the cage. Furthermore, McCune (1994) described five factors which may help to reduce stress in cats housed in single cages during the first few days in the shelter: bold and friendly temperament of the cat, advanced age, short travelling time to the shelter, short waiting time before caging and previous experience of caging.

Rochlitz *et al* (1995) studied behavioural parameters and changes in urinary cortisol of cats housed singly during the first five weeks in quarantine. Such behaviour as rolling, stretching and locomotion increased after the first week. However, only at the beginning of the fifth week did the cats spend more time resting on elevated places and grooming themselves. Their urinary cortisol level also decreased in the fifth week and the cats spent less time in hiding. Rochlitz *et al* (1995) concluded that cats require between two to five weeks to adapt to the quarantine situation.

The behaviour of a resident group of cats adapted to the animal shelter was shown to be a suitable basis for comparison with the behaviour of newly introduced cats to different housing conditions in animal shelters and boarding catteries (Smith *et al* 1990; Bradshaw 1992; McCune 1992; Roy 1992). The present study employed such a reference system with resident animals, socialized to conspecifics. Prior to the observations these control animals had been housed in a group for between 2 and 16 weeks (mean 29 days) with a stable group composition for at least five days. Comparative investigations were also made in order to assess stress levels of cats housed singly, in pairs and in groups at boarding catteries.

Considering the importance of animal shelters as rescue stations for homeless animals and of boarding catteries as temporary housing for boarding cats, there is insufficient information about how the adaptation process develops in spatially and socially different housing conditions. The aim of this study was to investigate the development of stress in cats housed singly, in pairs and in groups, and to determine if a two-week stay in a boarding cattery is long enough for cats to adapt and to reach the stress level of control groups that have been

at the shelter for several weeks longer. To assess stress levels, the present study applied a seven-level Cat-Stress-Score, representing a further development of McCune's (1994) scale.

Methods

Subjects and housing

One hundred and forty boarding cats (age 1–15 years) housed singly, in pairs or in groups were observed during the first 14 days of their stay in a boarding cattery and compared to 45 homeless animals, which were held in six control groups (Table 1). Thirteen of the boarding cats were pedigree cats while the others were common domestic mixtures.

Table 1 Number and type of boarding (n = 140) and control cats (n = 45) observed during two weeks in the boarding cattery/animal shelter.

Type of cat	Boarding cats (n)			Control cats ¹ (n)
	Housed singly	Housed in pairs	Housed in groups	Housed in groups
<i>Total subjects</i>	60	40	40	45
<i>Neutered males</i>	37	19	21	25
<i>Intact males</i>	1	0	0	0
<i>Neutered females</i>	20	20	18	20
<i>Intact females</i>	2	1	1	0
<i>Pedigree cats</i>	6	4	3	0
<i>Average age (years)</i>	5.9	5.4	5.2	3.1
<i>Area per animal (m²)</i>	3.2	1.6	2.8	3.2

¹ Total values for all control groups (see text)

The 60 cats housed singly in the cattery came from single-cat households. The 40 animals housed in pairs were kept as pairs in their respective households. Ten of the 40 cats housed in groups were either kept in pairs or in groups in the same household and were integrated together into the same boarding group at the cattery. The other 30 cats housed in groups came from single-cat households. The decision as to whether a cat should be housed singly, in pairs or in groups in the cattery was made by the owner of the cat and could not have been influenced. All cats housed in groups were integrated into pre-existing groups of boarding cats.

Eighty-five per cent of the boarding cats, housed singly and in pairs and 87 per cent of the boarding cats housed in groups had previously stayed at least once in the same cattery. Animals that were boarded in the same cattery within the previous three months or fell ill during their present stay were excluded from the observations. The pedigree cats did not differ in their stress levels on any observation day from the other cats under the same housing condition. Therefore, they were not treated separately in the data analysis.

A group was considered a control group if all members of the group had lived in the group enclosure of the shelter for at least two weeks and if no admissions or discharges had occurred in the five days prior to the observations. The density of the cats in the enclosure had to be between 0.2 and 0.5 animals per m² to be considered as a control group. Moreover, all animals of the control group had to be socialized towards other cats otherwise they were not observed. Socialization towards other cats was determined by means of an interview with the shelter staff and on the basis of the results of a questionnaire on socialization, completed by the person delivering the cat to the cattery.

Six different control groups were observed. The mean group density was 0.4 animals per m². The control cats had lived in the group enclosure between 2 and 16 weeks (mean 29 days) before the observations took place. Moreover, before the animals were placed into the control group enclosure they had been in the quarantine station of the shelter for two to six weeks (mean 21 days).

The observations took place in the boarding catteries/animal shelters of Zurich Animal Protection and the Swiss Animal Ambulance. The 36 single cages for boarding cats in the Zurich Animal Protection had two parts measuring 0.9x1.0x0.7m inside and 0.9x2.5x0.7m outside (WxDxH) connected by a small passage (0.2x0.2m). Indoors and outdoors there was a shelf 0.3m above the floor. A litter tray was supplied under the shelf in the indoor section of the cage. In the outdoor part of the cage there was a vertical wooden trunk. Animals housed in pairs were held in the same type of cage.

The group room (4.7x7.2x2.3m) for boarding cats in the Swiss Animal Ambulance cattery consisted of two similar chambers, connected by an open double-door (1.4x1.8m). The room contained a number of elevated boards, retreat areas, scratching surfaces, toys and litter trays.

The observations of the control cats took place in two different group rooms. 1) Three groups of seven to nine animals were observed in the Swiss Animal Ambulance shelter. Their group room consisted of a main room (3.8x4.6x2.3m) and a small room (3.4x1.9x1.8m) connected by an open door. 2) Three groups of six to eight animals were observed in the Zurich Animal Protection shelter. Their group room consisted of an indoor room (2.4x2.3x2.3m) and an outdoor enclosure (4.4x2.9x2.2m), connected by a small open passage (0.2x0.2m). Both group rooms contained various elevated shelves, retreat areas, scratching surfaces, toys and litter trays. There were no detectable differences in stress levels between the control animals in the two shelters. Therefore, they were not treated separately in the data analysis.

Cat-Stress-Score

The stress level of a cat was recorded by a Cat-Stress-Score, based on the Cat-Assessment-Score of McCune (1994). The Cat-Stress-Score describes seven possible stress levels of a cat based upon posture and behavioural elements (Table 2). The scores ranged from 'fully relaxed' (score 1) to 'extremely stressed' (score 7). The behaviour described in the Cat-Stress-Score is based on the ethogram developed by the UK Cat Behaviour Working Group (1995).

The Cat-Stress-Score used in this study was developed in a pilot study where observations of about 300 cats were made under single-, pair- and group-housing conditions in animal shelters and boarding catteries. First, the cats were scored with the Cat-Assessment-Score

(McCune 1994). Subsequently, behaviour and posture elements of cats that clearly showed one of the seven scores described in the Cat-Assessment-Score (McCune 1994) were recorded for 15 minutes (provided that the score of the cat did not change during the observation time). The recorded behaviour and posture elements were added to McCune's (1994) Cat-Assessment-Score resulting in a more detailed description of each stress level and allowing a finer differentiation of the levels. In particular, the Cat-Assessment-Score was supplemented with active behavioural elements and a 'tense sleeping posture' under score 4. Pfleiderer (1990) describes this sleeping posture in felids and other carnivores in zoos as a 'defensive sleep' as opposed to a 'restful sleep'. In order to avoid the influence of socialization of the cat towards humans, on scoring, the behaviour of the cats towards humans and their whereabouts in the cage were not used in this appraisal. The present Cat-Stress-Score can be applied in all housing forms, but not when temperatures drop below 15°C, because the animals do not assume a relaxed posture in the cold.

The scoring in this study was done by the same observer. However, the inter-observer reliability of the Cat-Stress-Score was also examined. The inter-observer reliability was 0.9 when two trained observers were used. Observations by shelter staff with less training resulted in a reliability of 0.75.

Procedure

The Cat-Stress-Score of each boarding cat was assessed four times during each of the first 14 days of the stay in the boarding cattery. The observations started at 1030 and 1630h, and were repeated once within an interval of 15 minutes. On the first boarding day, the initial scoring of the cats occurred at least two hours after they were put in the cage, because the most pronounced decrease in stress has been found to occur during the first 10 minutes and between the first and the second hour after placing a cat into a cage (McCune 1992). The boarding cats arrived at the cattery between 0800 and 1430h. Therefore, some were only scored in the afternoon on the first boarding day.

The observations were made between feeding times in the early morning and evening. Data on group-housed boarding cats were excluded if more than three exchanges of cats in the group (entrance or discharge) took place on one day, or if more than 10 exchanges happened during the first 14 days of the stay. Before data collection, the observer spent 10 minutes in the boarding room of the cages or in front of the group enclosure to give the cats a chance to become accustomed to the observer's presence. The Cat-Stress-Score of each cat was assessed after an initial one minute observation in front of the cage.

Data on the control animals were collected in the same way as those on the boarding cats, four times a day and at the same observation times. Four groups of control animals were observed during 14 days and two groups during 10 days.

Data analysis

The four Cat-Stress-Scores collected on an observation day (or two on the first day) were averaged for each cat because the scores of any one day did not differ more than one score level. From these daily mean scores, medians were calculated for each boarding day in every housing type. Similarly, for the control animals, the four scores of each observation day were averaged for every control animal. An overall median Cat-Stress-Score was calculated for all control animals on the 76 observation days.

Table 2 Seven-level Cat-Stress-Score (a further development of the Cat-Assessment-Score by McCune 1994).

Score	Body	Belly	Legs	Tail	Head
<i>1 Fully relaxed</i>	<i>i</i> : laid out on side or on back <i>a</i> : not applicable	exposed, slow ventilation	<i>i</i> : fully extended <i>a</i> : not applicable	<i>i</i> : extended or loosely wrapped <i>a</i> : not applicable	laid on the surface with chin upwards or on the surface
<i>2 Weakly relaxed</i>	<i>i</i> : laid ventrally or half on side or sitting <i>a</i> : standing or moving, back horizontal	exposed or not exposed, slow or normal ventilation	<i>i</i> : bent, hind legs may be laid out <i>a</i> : when standing extended	<i>i</i> : extended or loosely wrapped <i>a</i> : tail up or loosely downwards	laid on the surface or over the body, some movement
<i>3 Weakly tense</i>	<i>i</i> : laid ventrally or sitting <i>a</i> : standing or moving, back horizontal	not exposed, normal ventilation	<i>i</i> : bent <i>a</i> : when standing extended	<i>i</i> : on the body or curved backwards, may be twitching <i>a</i> : up or tense downwards, may be twitching	over the body, some movement
<i>4 Very tense</i>	<i>i</i> : laid ventral, rolled or sitting <i>a</i> : standing or moving, body behind lower than in front	not exposed, normal ventilation	<i>i</i> : bent <i>a</i> : when standing hind legs bent, in front extended	<i>i</i> : close to the body <i>a</i> : tense downwards or curled forward, may be twitching	over the body or pressed to body, little or no movement
<i>5 Fearful, stiff</i>	<i>i</i> : laid ventrally or sitting <i>a</i> : standing or moving, body behind lower than in front	not exposed, normal or fast ventilation	<i>i</i> : bent <i>a</i> : bent near to surface	<i>i</i> : close to the body <i>a</i> : curled forward close to the body	on the plane of the body, less or no movement
<i>6 Very fearful</i>	<i>i</i> : laid ventrally or crouched directly on top of all paws, may be shaking <i>a</i> : whole body near to ground, crawling, may be shaking	not exposed, fast ventilation	<i>i</i> : bent <i>a</i> : bent near to surface	<i>i</i> : close to the body <i>a</i> : curled forward close to the body	near to surface, motionless
<i>7 Terrorized</i>	<i>i</i> : crouched directly on top of all fours, shaking <i>a</i> : not applicable	not exposed, fast ventilation	<i>i</i> : bent <i>a</i> : not applicable	<i>i</i> : close to the body <i>a</i> : not applicable	lower than the body, motionless

i = inactive, *a* = active

Score	Eyes	Pupils	Ears	Whiskers	Vocalization	Activity
<i>1 Fully relaxed</i>	closed or half opened, may be blinking slowly	normal	half back (normal)	lateral (normal)	none	sleeping or resting
<i>2 Weakly relaxed</i>	closed, half opened or normal opened	normal	half back (normal) or erected to front	lateral (normal) or forward (normal)	none	sleeping, resting, alert or active, may be playing
<i>3 Weakly tense</i>	normal opened	normal	half back (normal) or erected to front or back and forward on head	lateral (normal) or forward	meow or quiet	resting, awake or actively exploring
<i>4 Very tense</i>	widely opened or pressed together	normal or partially dilated	erected to front or back, or back and forward on head	lateral (normal) or forward	meow, plaintive meow or quiet	cramped sleeping, resting or alert, may be actively exploring, trying to escape
<i>5 Fearful, stiff</i>	widely opened	dilated	partially flattened	lateral (normal), forward or back	plaintive meow, yowling, growling or quiet	alert, may be actively trying to escape
<i>6 Very fearful</i>	fully opened	fully dilated	fully flattened	back	plaintive meow, yowling, growling or quiet	motionless alert or actively prowling
<i>7 Terrorized</i>	fully opened	fully dilated	fully flattened back on head	back	plaintive meow, yowling, growling or quiet	motionless alert

Wilcoxon signed rank tests were used to detect differences between the 14 boarding days. The stress levels of the boarding cats under single-, pair- and group-housing conditions were compared with the stress levels of the control cats using two sample Kolmogorov-Smirnov tests. Comparisons between different housing conditions (single, paired, grouped) were made by Kruskal-Wallis tests. The relationship between age and mean Cat-Stress-Score of the cats was examined by Spearman rank correlation tests. StatView 4.0[®] (Abacus Concepts Inc, Berkeley, USA) was used for statistical calculations.

Results

The daily mean Cat-Stress-Scores of the 60 cats housed singly declined significantly from day 1 to day 5. The daily mean Cat-Stress-Scores of the 40 cats housed in pairs and in groups declined significantly from day 1 to day 4 (Table 3).

Table 3 Differences between daily mean Cat-Stress-Scores (ie mean score for day 1 minus mean score for day 2, etc) during the first boarding week in cats housed singly, in pairs and in groups.

Day	Mean difference between Cat-Stress-Scores		
	Housed singly	Housed in pairs	Housed in groups
Day 1 to day 2	0.63***	0.76***	0.75***
Day 2 to day 3	0.30**	0.59***	0.23*
Day 3 to day 4	0.25***	0.22*	0.26**
Day 4 to day 5	0.20**	0.10	0.05
Day 5 to day 6	0.07	0.11	0.19
Day 6 to day 7	0.11	0.05	0.10

Levels of significance between days: *** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$

The median (and mean) Cat-Stress-Score of the 45 animals in the six control groups for 76 observation days was 2.6. The daily mean Cat-Stress-Scores of the control animals ranged from 1.8 to 3.5. The stress levels of the control animals were constant over the observation time.

The daily mean scores of the cats housed singly ($n = 60$), in pairs ($n = 40$) and in groups ($n = 40$) were significantly higher than the daily mean scores of the control animals on each of the 14 boarding days ($\chi^2 > 11.4$, $P < 0.01$).

Figures 1a and 1b illustrate the frequency distribution of the median Cat-Stress-Scores ($n = 140$) of the boarding animals in the first and second week. In the first week, 75 per cent of the animals scored above the level 'weakly tense' (= score 3, Table 2) and 24 per cent of the animals scored above the level 'very tense' (= score 4). In the second week, 35 per cent of the animals scored above the level weakly tense and 4 per cent (six animals) had a median Cat-Stress-Score more than very tense.

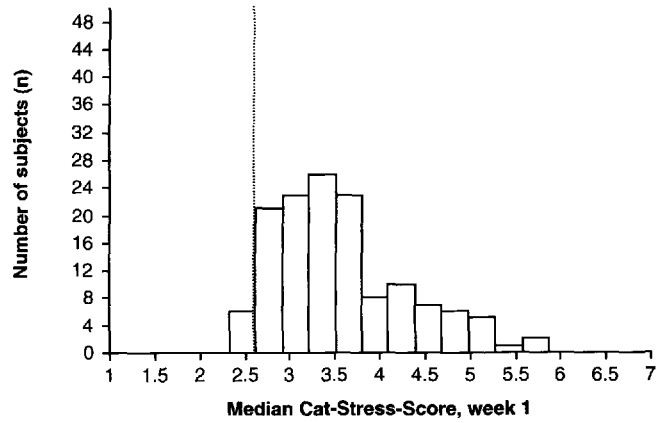


Figure 1a The frequency distribution of the boarding cats ($n = 140$) median Cat-Stress-Scores during the first boarding week in the cattery (single, paired and grouped). The dotted line shows the overall median Cat-Stress-Score of control animals in the shelter ($n = 45$).

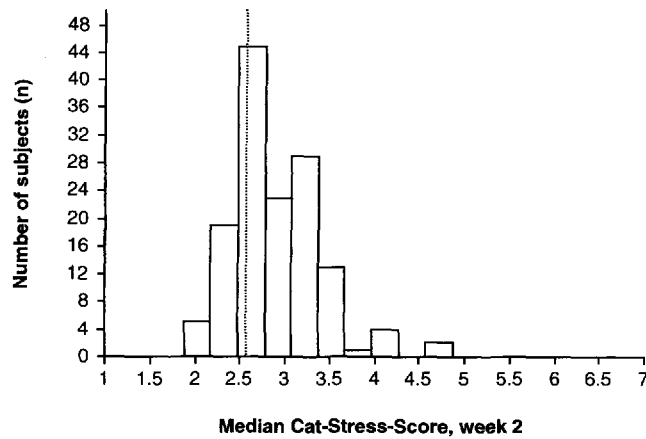


Figure 1b The frequency distribution of the boarding cats ($n = 140$) median Cat-Stress-Scores during the second boarding week in the cattery (single, paired and grouped). The dotted line shows the overall median Cat-Stress-Score of control animals in the shelter ($n = 45$).

The daily mean Cat-Stress-Scores of the cats housed singly, in pairs and in groups did not differ significantly on any of the 14 boarding days (Figure 2).

The age of the animals did not significantly influence the mean Cat-Stress-Scores of the boarding cats housed singly, in pairs and in groups on any boarding day.

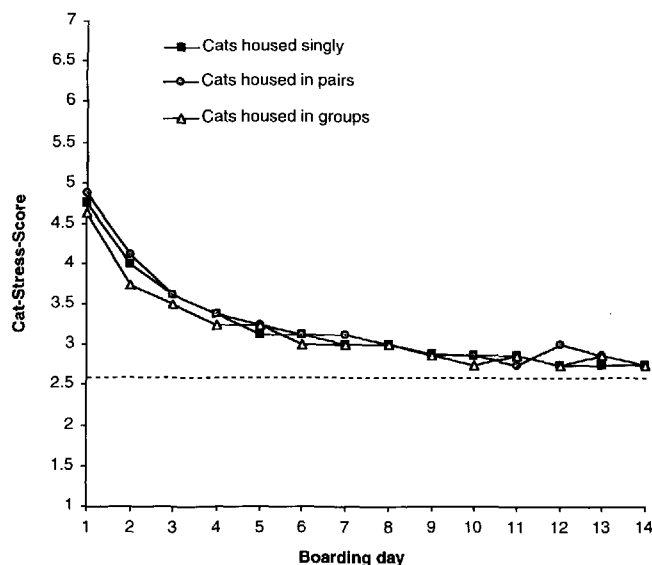


Figure 2 The development of stress (daily median Cat-Stress-Score) in animals housed singly ($n = 60$), in pairs ($n = 40$) and in groups ($n = 40$) during the first two weeks in the cattery. The dotted line shows the overall median Cat-Stress-Score of control animals in the shelter ($n = 45$).

Discussion

Overall the levels of stress in boarding cats decreased during the two-week stay in the boarding cattery, but did not quite reach the stress level of the more established control groups. Although the control animals were homeless cats with a lower average age (but still adult), this indicates that, in general, the process of adjustment to a boarding cattery takes more than two weeks. This is in agreement with the findings of Smith *et al* (1990) and Rochlitz *et al* (1995).

During the first four boarding days a pronounced decline in stress occurred in the boarding cats, which supports the findings of Smith *et al* (1990) and McCune (1992). In the second boarding week the median stress level of about two thirds of the animals was at the weakly tense or lower levels. Assuming that the observed boarding cats are representative of the boarding cat population, these low stress levels indicate that for about two thirds of all boarded cats a temporary stay of two weeks in a boarding cattery is an acceptable option in the case of owner absence.

However, for about one third of the animals, the stay in the cattery represents a prolonged stressful situation. These animals might therefore be better kept in their usual surroundings during a two-week absence of the owner. A small proportion of the cats (4%) showed hardly any reduction of their high stress levels during the two weeks in the cattery. Continuous stress can lead to physical harm and behavioural disturbance (see Stauffacher 1993). Therefore, a two-week stay in a cattery is considered inappropriate for these cats.

The majority of the boarding cats in the present study had been in the boarding cattery before and adjusted more rapidly to the cattery than the cats in the study by Rochlitz *et al* (1995) adjusted to quarantine. McCune (1994) also found a more rapid decline of stress in cats when they had previous experience with animal shelters. In the present study, a comparison of cats with boarding experience and cats with no experience of boarding catteries was not possible because of the variable time period after the last stay and the variable frequency of the stays in the cattery. Also, the mean area available per animal was 2 to 3m². This is a more generous floor area than available in many other Swiss animal shelters and catteries (Kessler 1997). Exactly how the absolute size of the cages and the cat density in group-housing situations affects the adjustment process requires further investigation.

The control cats had a stress level between weakly relaxed and weakly tense (mean score 2.6) after they had been housed in the group enclosure between 2 and 16 weeks (mean 29 days). The range of stress levels in the control cats was small and did not change over time, whereas Smith *et al* (1990) and Rochlitz *et al* (1995) found indications of a further reduction of stress in cats that spent more than one month in a shelter or quarantine station. This discrepancy may be due to the situation in our study where highly stressed cats were housed singly in order to control their nutrition, water intake and defecation more effectively. However, the continuously low stress levels in our study indicate that the control animals were well used to the group enclosures in the shelter.

Boarding cats housed singly, in pairs or in groups did not differ in their stress levels on any day of their two-week stay in the cattery. In the pair-housing situation only animals familiar with each other were housed together, which probably influenced (lowered) their stress scores relative to the scores one might record when two unfamiliar (but social) animals are housed together. To avoid the possibility of social stress in the group-housing situation, Smith *et al* (1990) recommended single-housing conditions for short stays. Our results on the group-housed boarding cats imply that more spacious group-housing conditions might help to compensate for the additional stress caused by unfamiliar group members during the first two weeks of the stay. However, it must be remembered that most of the cats in this study had previous experience in the housing conditions under which they were observed. This experience may allow them to adjust to other housing types in a similar way.

Contrary to McCune's (1992) findings, the age of the cats did not influence the adjustment process of the boarding cats. This might be due to the higher average age, the greater space availability or the modified Stress-Score applied in this study. The differentiation between a restful and a stressful sleeping posture and the integration of active elements in the Cat-Stress-Score used in this study may have led to a different scoring in young and old animals, compared to the study by McCune (1992).

A cat with a high stress level is often inconspicuous because it shows little activity. It is very easy to misinterpret such a cat as being non-stressed, when indeed it may be highly

stressed. A detailed description of the behavioural and postural signs of stress, as considered in this study, helps to distinguish between stressed and non-stressed cats, even for non-experienced animal observers. The present Cat-Stress-Score is a useful method for ethological stress detection and also yields other information for the shelter staff or animal owners. The score has a high inter-observer reliability when used by experienced animal observers, and in comparison with physiological stress measures, stress detection is much quicker and non-invasive. However, an examination of the Cat-Stress-Score together with physiological parameters would substantiate its validity and increase its acceptance.

Animal welfare implications

Pet owners care about the welfare of their animals even during their absence. The boarding cattery was a suitable solution for about two thirds of the cats studied, in the case of an owner's absence of two weeks. For the others, temporary boarding was more stressful, especially for 4 per cent of the cats, where other solutions have to be explored. The Cat-Stress-Score is a practical, non-invasive stress detection method that can be used for further research on the welfare of cats housed in shelters and catteries.

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