

## A Comparison of Tethering and Pen Confinement of Dogs

Seong C. Yeon, Glen Golden, Wailani Sung, Hollis N. Erb,  
Arleigh J. Reynolds, and Katherine A. Houpt

*College of Veterinary Medicine  
Cornell University*

This study compared general activity and specific behaviors of 30 adult Alaskan sled dogs, 19 male and 11 female dogs, on 3.5 m tethers and in 5.9 m<sup>2</sup> pens. The investigators used activity level and stereotypies as indicators of welfare. The dogs spent most of their time inactive, either lying or sitting both on the tether and in the pen. They had more opportunity for interaction with one another but less space in the pen (5.9 m<sup>2</sup> in the pen vs. 38.5 m<sup>2</sup> on the tether). Standing on the hind legs ( $p < .05$ ) occurred more frequently in the pens; circling was more frequent on the tethers ( $p < .05$ ). The U.S. Department of Agriculture approves penning but not tethering of dogs; however, the behavior of the dogs in this study did not indicate an improvement in welfare in pens.

There is agreement that proper housing is necessary for optimal canine welfare; however, despite research on some aspects, there is no agreement about what is a good housing environment for dogs. Space, exercise, and enrichment have been the subject of previous studies. The major differences in behavior occurred, however, not with increase in size but with either social or environmental enrichment.

Hubrecht (1995) compared groups of dogs living in pens of 700 m<sup>2</sup> or 7 m<sup>2</sup>. There were few differences in the main behavior classifications of active or inactive, but there were more repetitive behaviors in the larger pens. Larger pens resulted in more trotting and running. Hughes and Campbell (1989) studied beagles in cages measuring 12 m × 1 m or 1 m × 2 m and found that the dogs in the smaller cages traveled five times farther than those in the larger cages and were more ac-

tive (8% vs. 11%). When the social behaviors of beagles in large (2.4 m × 3 m) and small (2.4 m × 0.9 m) cages were compared, there were no differences in aggression or play, but the dogs in larger cages were farther from one another.

In an evaluation of the effects of different spatial areas and social conditions on behaviors of beagles maintained in a laboratory, Hetts, Clark, Calpin, Arnold, and Mateo (1992) reported social isolation may be as harmful as, or more harmful than, spatial restriction. Newton (1972) compared muscle enzyme and calcium kinetics in beagles kept in cages (1 m × 1 m), in runs (1.3 m × 1.3 m), or in cages with 30 min access to a run daily and found no differences among the three groups. Hite, Hanson, Bohidar, Conti, and Mattis (1977) found differences in behavior between beagles kept in 1 m × 1 m cages and those kept in 3 m × 1 m cages. The dogs in larger cages sat and lay more than those in smaller cages. Campbell, Hughes, Griffin, Landi, and Mallon (1988) found no physiological differences (heart rate, cortisol, or immune function) between dogs housed in large or small cages, nor were there differences in sitting, standing, or lying. Activity occurred only when humans were in the room. Clark, Calpin, and Armstrong (1991) reported that beagles kept in large outdoor pens (6.1 m × 9.1 m) were more fit than those kept in cages (0.7 m × 0.9 m).

Hubrecht, Serpell, and Poole (1992) and Hubrecht (1993) found that a dog's behavior was very different in different types and sizes of pens and that appropriate enrichment can increase the complexity of that behavior, substantially changing its expression and helping to prevent undesirable behavior. Clark, Rager, Crowell-Davis, and Evans (1997) compared the effect of exercise periods on caged beagles and found that the exercised dogs barked more frequently but found no other differences between the groups.

Tethering has been used for centuries to restrain dogs. It is used for dogs guarding houses to ensure that the dog stays near the entrance to the house rather than wandering off. It is most commonly used for sled dogs such as those used by arctic explorers. Today's sled dog racers use tethering to restrain their dogs because (a) pens would not be practical on the trail and (b) the dogs might fight if confined together. Under pressure from individuals who felt tethering was cruel, the U.S. Department of Agriculture (USDA) banned the practice for those dogs in kennels and research facilities under its jurisdiction (Animal and Plant Health Inspection Service, 1997). Hubrecht (1995) reported that between 1990 and 1992, the Royal Society for Prevention of Cruelty to Animals convicted two persons for allowing dogs to strangle on a tether.

Owners who do not have a close relationship with their dog may tether the dog outside 24 hr a day for years at a time. Nevertheless, when investigating canine exercise physiology, it is necessary to house the dogs as they are housed during conditioning and racing. If the dogs were caged or penned, the results might not be valid. We took advantage of the fact that sled dogs at a research facility had to be moved from tethers to pens because of the recent USDA ruling to determine if

there was an indication of an improvement in their welfare in pens. The ruling could be modified if tethering was shown to have no adverse effects on dogs. This study employed behavioral measures in an effort to assess the dog's welfare in the two environments: tethering and penning. The purpose was to determine whether tethering was detrimental to the dog's welfare.

## METHODS AND ANIMALS

### Animals and Observation Methods

The subjects were 30 Alaskan sled dogs: 19 male and 11 female (mean age =  $56.8 \pm 9.3$  months). Observations took place in the morning (1000 to 1200 hr) and in the afternoon (1600 to 1800 hr) from April to August 1997. Observation time was selected by the observers to avoid the dog's morning feeding. Total observation time was 160 hr for all dogs (80 hr over 2 months in each condition). The behavior and location of each dog was recorded every 2 min using an instantaneous point sampling method. Whether the activity was performed inside or outside a shelter was also noted. The behavior categories recorded are described in Table 1.

The behaviors were mutually exclusive. Active behavior includes only nonstereotypic activities. To reduce any disturbance that might be caused by the presence of a person, the observer—who was visible to all the dogs—arrived about 10 min before the observation time started and also visited the field at other times.

### Housing Conditions

In the first housing environment (tether), the dogs were tethered by a 3.5 m chain from their collars to a stake that allowed a total area of 38.5 m<sup>2</sup> (see Figure 1).

The dogs could not interact directly with their neighbors. Touching their noses to their neighbors' tail areas was the maximum contact dogs had with their closest neighbors. Each dog had a wooden shelter (1.3 m<sup>2</sup>) for shade. Four commercial pallets nailed together allowed for two vertical openings—pallet slats alternated in position on either side of the frame, allowing for air circulation. The slats served as the floor. There also was a plastic barrel (0.5 m<sup>2</sup>) with straw as bedding. Water was available *ad libitum* in a large metal bucket in the wood shelter. The dogs were separated by sex into two fenced yards open to environmental stimuli such as squirrels and passersby using a trail that ran beside the yards.

The tether condition was imposed first. The dogs had been housed on tethers for some years, essentially their adult lives. Later the dogs were transferred to pens. Although it would have been better experimental design to control for or-

TABLE 1  
Behavior Categories Used in This Study

<i>Summed Category</i>	<i>Category</i>	<i>Definition</i>
Active	Walk	Moving in 4-beat gait
	Trot	Moving in 2-beat gait in which diagonal limbs move at the same time
Active repetitive or stereotyped	Run	Three-beat gait
	Hind legs	Standing on hind legs
	Circle	Repetitive circling around pen or stake
	Pace	Repetitive walking back and forth
	Jump	Repetitive jumping so that hind legs leave the ground
Inactive	Lie in barrel	Lying down in barrel
	Lie in shelter	Lying down in shelter
	Lie outside shelter	Lying down outside shelter
	Lie top of barrel	Lying down top of barrel
	Lie top of shelter	Lying down top of shelter
	Sitting in shelter	Sit on hind legs in shelter
	Sitting outside shelter	Sit on hind legs outside shelter
	Sitting top of shelter	Sit on hind legs top of shelter
	Standing inside shelter	Stand on four legs inside shelter
	Standing outside shelter	Stand on four legs outside shelter
	Standing top of barrel	Stand on four legs top of barrel
Standing top of shelter	Stand on four legs top of shelter	
Socializes	Solicit play	Bow, often barking
	Playing toy	Playing with toy
Alimentary	Urination	Urination either squatting or leg lifting
	Eat	Eating food
	Drink	Drinking/mouth at drinking nipple
Vocalization	Defecating	Squat and eliminate feces
	Growl	A low pitched threatening sound
	Howl	Long drawn-out vocalization
	Whine	A long high complaining cry
Others	Bark	Staccato vocalization
	Grooming	Lick, pull at body
	Scratch	Scratching ground
	Dig	Dig at ground with fore paws
	Chew	Chew non nutritive material
	Sniff	Nose to ground or objects
	Taut chain	Pulling the chain
Bite	Bite toy or objects (fence)	

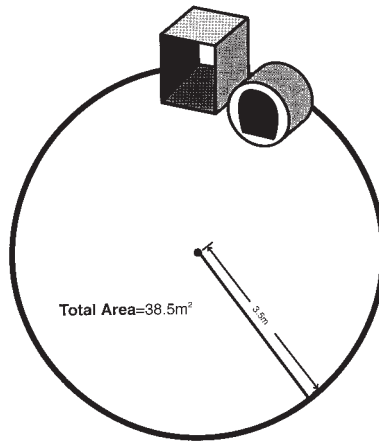


FIGURE 1 Tether environment.

der of testing, the USDA's tethering rule prevented the dogs from being tethered again, so the experiment could not control for order effects. Two weeks were allowed for adaptation to the pen before observations were resumed in the second housing environment (pen). In the pen, each dog was housed in a 5.9 m<sup>2</sup> outdoor kennel (see Figure 2) that included a fabric shade (2.2 m<sup>2</sup>) and plywood shelf (1.3 m<sup>2</sup>).

Each had an adjacent wooden barrel (0.7 m<sup>2</sup>) in the building. A chain link fence separated each dog from the next, but they could interact more than on the tether. The male and female dogs were housed separately on either side of the building and were observed sequentially with the sex observed first alternated. In the pens, the dogs received toys with which to play. Water was available ad libitum in a large metal bucket. In this condition, the dogs were shielded from all environmental stimuli by a wooden stockade fence (2.4 m high) surrounding the enclosure, which also may have reduced the movement of air throughout the area. This second housing environment was approved by the USDA.

Daily temperatures were taken at a point 1 km from the tethering site and pen. The average high temperature when the dogs were observed on the tether was 14.3 ± 5.7 °C and the average high temperature when the dogs were observed in the pen was 26.1 ± 3.4 °C.

To test for the effect of seasonal differences, the behavior of a separate group of tethered sled dogs was compared to that of penned dogs in the summer. Although the tethered dogs (19 male and 17 female) observed in the summer were different, the management, location, and observation methods were the same. These dogs were observed from 1600 to 1800 hr for a total of 36 hr. The average temperature was 27.7 ± 2.5 °C at a point 1 km from the tethering site.

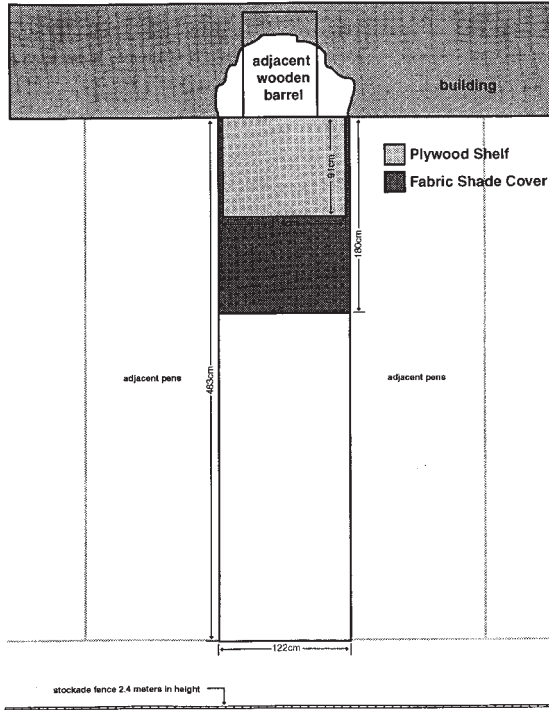


FIGURE 2 Standard dog pen (approved by U.S. Department of Agriculture).

### Statistical Analysis

The Wilcoxon signed rank test was used to compare the differences in behavior between tether and pen and between morning and afternoon in the same dogs (paired data). The Mann–Whitney *U* test was employed to compare male and female dogs. The 5% level of significance was used both with and without Bonferroni correction; the former allows a liberal search for leads for further research, and the latter recognizes that a great many comparisons were made. Only the Bonferroni-corrected significance levels are reported.

## RESULTS

The overall time budgets of the dogs under each condition were similar in that they spent most of their time inactive, either lying or sitting. With the exception of stereotypic behavior, which was considered a welfare indicator (Mench & Mason, 1997), only behaviors were analyzed that occupied more than 0.5% of the total time budget

of dogs in the tether or pen. There were significant increases ( $p < .05$ ) of standing on the hind legs ( $z = -4.46$ ), pacing ( $z = -4.05$ ), lying inside the shelter ( $z = -5.01$ ), and eating food ( $z = -2.54$ ) in the pen in comparison to the tether. There was a significant decrease in chewing objects ( $z = -2.89$ ) in the pen compared with on the tether (see Table 2). If toy play in the pen is compared with chewing on the tether, there was less oral activity in the pen ( $z = -3.316$ ). Dogs circled more (0.95%) when on the tether than in the pen (0.03%) but spent 1% of their time pacing in the pen. If circling on tether is compared with pacing in the pen, the dogs exhibited significantly more stereotypic locomotor behavior in the pen ( $z = 3.37$ ). Fence biting (0.09%) and fence climbing (0.01%) were new behaviors adopted in the new housing after moving to the pen.

When there were significant differences in a behavior between sexes or between morning and afternoon, these behaviors were analyzed separately by sex or time (i.e., the analyses were stratified; see Table 3). The dogs spent most of their time in a recumbent position on the tether (male dogs 72.5% and female dogs 67.8%) and in the pen (male dogs 64.5% and female dogs 66.8%). The dogs were inactive, either lying or sitting (male dogs 85.7%, female dogs 76%) when on the tether and when in the pen (male dogs 81%, female dogs 84.2%). Whines tended to increase in the pen (0.17%) in comparison to on the tether (0.08%,  $p = .055$ ). Female dogs walked more on the tether than in the pen in both the morning and afternoon. In the afternoon, both male and female dogs trotted more on the tether than in the pen. Female dogs circled more on the tether. Male dogs lay outside the shelter more on the tether; female dogs did also, but only in the afternoons. Male dogs lay on top of the shelter more in the pens, and both sexes sat in the shelter more in the pens. Female dogs sat outside the shelter more often on the tether; the difference was seen in male dogs only in the afternoon. Male dogs stood in the shelter less on the tether; the differences were seen in female dogs only in the afternoon. In the afternoon, male dogs were observed to drink less on the tether. (See Table 4 for

TABLE 2  
Behavior of Dogs on Tether and in Pens

Behavior	Tether			Pen		
	$Q_1$	<i>Mdn</i>	$Q_3$	$Q_1$	<i>Mdn</i>	$Q_3$
Standing on hind leg	0.00	0.00 <sup>a</sup>	0.10	0.14	0.53	0.86
Pace	0.00	0.09 <sup>a</sup>	0.36	0.22	1.06	5.15
Lie in shelter	0.23	1.27 <sup>a</sup>	2.89	17.75	25.21	34.77
Eating food	0.38	0.78 <sup>a</sup>	0.99	0.55	1.00	1.44
Chew	0.00	0.10 <sup>a</sup>	0.92	0.00	0.00	0.23

Note.  $Q_1$  = first quartile;  $Q_3$  = third quartile.

<sup>a</sup>Medians are significantly different between tether and pen ( $p \leq .05$ ).

TABLE 3  
Sex, Time of Day, and Environmental Effects on Sled Dog Behavior

<i>Behavior</i>	<i>Time</i>	<i>Gender</i>	<i>Tether</i>	<i>Pen</i>
Walk	Morning	Male	1.39 ± 0.42	1.42 ± 0.26
		Female	3.36 <sup>a,d</sup> ± 1.01	1.23 <sup>d</sup> ± 0.35
	Afternoon	Male	5.70 ± 1.00	3.47 ± 0.45
		Female	7.89 <sup>a</sup> ± 1.93	2.88 ± 0.44
Trot	Morning	Male	0.00 <sup>b,c</sup> ± 0.00	0.06 ± 0.03
		Female	0.45 <sup>d</sup> ± 0.34	0.09 ± 0.09
	Afternoon	Male	0.51 <sup>a,b</sup> ± 0.27	0.07 ± 0.05
		Female	2.33 <sup>a</sup> ± 1.22	0.06 ± 0.03
Circling	Morning	Male	0.19 <sup>b,c</sup> ± 0.12	0.01 ± 0.01
		Female	0.79 <sup>a</sup> ± 0.41	0.00 ± 0.00
	Afternoon	Male	1.60 ± 1.01	0.05 ± 0.02
		Female	1.75 <sup>a</sup> ± 0.57	0.02 ± 0.02
Lie outside shelter	Morning	Male	64.79 <sup>a,b,c</sup> ± 3.63	28.83 <sup>c</sup> ± 4.04
		Female	50.86 <sup>d</sup> ± 4.52	33.71 ± 5.39
	Afternoon	Male	42.53 <sup>a</sup> ± 3.46	7.83 ± 1.38
		Female	39.53 <sup>a</sup> ± 2.72	12.42 ± 2.06
Lie top of shelter	Morning	Male	0.00 <sup>a</sup> ± 0.00	4.11 ± 2.41
		Female	0.96 ± 0.42	2.55 ± 2.55
	Afternoon	Male	0.00 <sup>a</sup> ± 0.00	1.19 ± 0.38
		Female	0.52 ± 0.40	1.64 ± 1.35
Sitting inside shelter	Morning	Male	0.00 <sup>a,b</sup> ± 0.00	0.34 ± 0.10
		Female	0.07 <sup>a</sup> ± 0.05	0.77 <sup>d</sup> ± 0.21
	Afternoon	Male	0.35 <sup>a</sup> ± 0.20	1.73 ± 0.50
		Female	0.10 <sup>a</sup> ± 0.06	1.80 ± 0.43
Sitting outside shelter	Morning	Male	1.71 <sup>c</sup> ± 0.44	0.99 <sup>c</sup> ± 0.25
		Female	3.66 <sup>a</sup> ± 1.22	1.48 <sup>d</sup> ± 0.49
	Afternoon	Male	3.87 <sup>a</sup> ± 0.84	1.33 ± 0.42
		Female	7.38 <sup>a</sup> ± 1.71	2.17 ± 0.65
Standing inside shelter	Morning	Male	0.20 <sup>a,c</sup> ± 0.09	1.76 <sup>c</sup> ± 0.38
		Female	0.50 ± 0.16	1.10 <sup>d</sup> ± 0.43
	Afternoon	Male	0.97 <sup>a</sup> ± 0.23	5.36 ± 0.71
		Female	1.02 <sup>a</sup> ± 0.36	4.54 ± 0.71
Standing outside shelter	Morning	Male	5.03 <sup>c</sup> ± 1.15	5.03 <sup>bc</sup> ± 0.62
		Female	6.73 <sup>d</sup> ± 2.09	3.09 ± 0.54
	Afternoon	Male	14.31 ± 1.18	11.21 ± 1.09
		Female	13.03 ± 1.40	11.23 ± 1.46
Drinking	Morning	Male	0.06 <sup>c</sup> ± 0.04	0.16 <sup>c</sup> ± 0.05
		Female	0.13 ± 0.05	0.08 <sup>d</sup> ± 0.04
	Afternoon	Male	0.55 <sup>a</sup> ± 0.12	1.00 ± 0.12
		Female	0.88 ± 0.18	1.13 ± 0.18
Barking	Morning	Male	0.38 <sup>c</sup> ± 0.29	1.71 <sup>c</sup> ± 1.48
		Female	0.44 <sup>d</sup> ± 0.21	1.52 ± 1.36
	Afternoon	Male	0.89 ± 0.25	2.96 ± 1.91
		Female	1.03 ± 0.38	1.63 ± 0.76

<sup>a</sup>Means are significantly different ( $.05 \leq p \leq .0001$ ) between tether and pen. <sup>b</sup>Means are significantly different ( $.05 \leq p \leq .0001$ ) between male and female. <sup>c</sup>Means are significantly different ( $.05 \leq p \leq .0001$ ) between morning and afternoon in the male dog. <sup>d</sup>Means are significantly different ( $.05 \leq p \leq .0001$ ) between morning and afternoon in the female dog.



TABLE 4  
Comparison of Behaviors of Tethered and Penned Dogs in the Summer

<i>Behavior</i>	<i>Gender</i>	<i>1994 Tether</i>	<i>1997 Pen</i>
Walk	Male	11.43 <sup>ab</sup> ± 1.23	3.47 ± 0.45
	Female	8.80 <sup>a</sup> ± 2.05	2.88 ± 0.44
Trot	Male	5.32 <sup>ab</sup> ± 1.09	0.07 ± 0.05
	Female	2.49 <sup>a</sup> ± 0.93	0.06 ± 0.03
Running	Male	0.86 <sup>a</sup> ± 0.21	0.19 ± 0.08
	Female	0.63 ± 0.17	0.57 ± 0.40
Lie in barrel	Male	4.39 <sup>ab</sup> ± 0.80	16.42 ± 4.52
	Female	17.13 ± 4.59	20.10 ± 6.52
Lie in shelter	Male	7.33 <sup>a</sup> ± 1.96	27.95 ± 2.77
	Female	4.04 ± 1.12	21.32 ± 2.88
Lie outside shelter	Male	37.49 <sup>a</sup> ± 3.04	7.83 ± 1.38
	Female	38.96 <sup>a</sup> ± 3.64	12.42 ± 2.06
Lie top of shelter	Male	0.06 <sup>a</sup> ± 0.06	2.14 ± 1.43
	Female	0.21 ± 0.20	1.96 ± 1.96
Sitting inside shelter	Male	1.67 <sup>b</sup> ± 0.70	1.73 ± 0.05
	Female	0.10 <sup>a</sup> ± 0.05	1.80 ± 0.43
Sitting outside shelter	Male	4.55 <sup>a</sup> ± 1.38	1.33 ± 0.42
	Female	1.73 ± 0.48	2.17 ± 0.65
Standing inside shelter	Male	1.45 <sup>ab</sup> ± 0.50	5.36 ± 0.71
	Female	0.63 <sup>a</sup> ± 0.27	4.54 ± 0.71
Standing outside shelter	Male	8.26 ± 1.07	11.21 ± 1.09
	Female	8.29 ± 1.02	11.23 ± 1.46
Drinking	Male	0.71 ± 0.07	1.00 ± 0.12
	Female	0.70 <sup>a</sup> ± 0.14	1.13 ± 0.18
Eating food	Male	0.87 <sup>ab</sup> ± 0.08	2.04 ± 0.33
	Female	1.52 ± 0.18	1.34 ± 0.19
Sniffing	Male	0.43 <sup>a</sup> ± 0.07	3.50 ± 0.65
	Female	0.63 <sup>a</sup> ± 0.08	3.62 ± 0.73
Scratching	Male	0.57 <sup>a</sup> ± 0.15	0.08 ± 0.03
	Female	0.32 <sup>a</sup> ± 0.08	0.07 ± 0.03
Licking itself	Male	0.55 ± 0.10	0.35 ± 0.10
	Female	0.41 ± 0.08	0.26 ± 0.06
Barking	Male	0.36 <sup>a</sup> ± 0.12	2.96 ± 1.91
	Female	0.35 ± 0.10	1.63 ± 0.76

*Note.* Observations were made in the afternoon.

<sup>a</sup>Significantly different between tether and pen. <sup>b</sup>Significantly different between male and female.

the summer time behavior of sled dogs in pens and on tethers.) The tethered dogs of both sexes walked (female,  $w$  [Wilcoxon] = 102, male  $w$  = 206), trotted (female  $w$  = 82, male  $w$  = 193), stood outside the shelter (female  $w$  = 199, male  $w$  = 438), lay outside the shelter (female  $w$  = 76, male  $w$  = 198), scratched more (female  $w$  = 111, male  $w$  = 198), and sniffed less (female  $w$  = 244, male  $w$  = 579). All differences were significant at  $p < .05$ .

There were other differences that were significant ( $p < .05$ ) only for one sex. Pinned female dogs sat in the shelter significantly more ( $w$  = 238) and drank more ( $w$  = 213). Tethered male dogs sat inside the shelter significantly less ( $w$  = 433), lay on the shelter less ( $w$  = 420), lay in the shelter less ( $w$  = 523), and barked less ( $w$  = 453) but spent more time eating ( $w$  = 480) and running ( $w$  = 271). The dogs in the pen spent more time in the shelter and barrel, but the shelter occupied a larger percentage of the area available to the dogs in the pen (see Figures 1 and 2).

## DISCUSSION

In this study, housing conditions affected some kinds of behavior, but it is difficult to assess the welfare implications of the changes. The comparisons were between the same dogs in the two different environments and between different dogs in the same season (summer) on the tether and in the pen where similar activity decreased in the pen. Most active behavior (walking, trotting, and circling) decreased in the pen but pacing increased. Standing on the hind legs in the pen was more frequent than on the tether. Biting of objects and chewing behavior decreased in the pen, probably because toys were provided for the dogs, but toy use was not as frequent as chewing had been. Toys were not provided to the tethered dogs because they would lose the toys beyond the radius of the tether. Hubrecht (1993) found that following 2 months of environmental enrichment, dogs spent a substantial proportion of their time (24%) using the toys, showing that frequent changes of items—if the appropriate toys or chews are used—are not necessary to avoid habituation. The dogs in our study spent less than 1% of their time manipulating toys. The reason for these differences is not clear, but the dogs in our study were sled dogs—not selected for playfulness. In addition, the toys were not suspended as they were in the Hubrecht (1993) study. Finally, the dogs in this study were housed singly rather than in pairs where social facilitation may have increased toy use.

The two environments were different, and the object of the experiment was to compare the differences in behavior of the dogs in two different environments. One confounding effect was the seasonal differences in ambient temperature. To control for that factor, we compared the behavior of a different group of tethered dogs observed in the same environment in summer when the ambient temperatures were the same. We could not control for the shelter design, which was a much greater percentage of the space available to the penned dogs than to the tethered

dogs. Therefore, we did not compare shade use in the two environments. Presumably, the dogs spent more time in the shade in proportion to the greater availability of the shade. They did not seek an unshaded portion of the pen. Had the dogs remained in the pens in the winter—the colony was disbanded soon after the observations were made—the dogs preferentially may have selected the open areas.

Another confounding effect is that the dogs had spent most of their adult lives on tethers and were now in an environment they had not lived in since they were puppies. Although there have been many studies of the effect of prior environment on the behavior of farm animals in a new environment—in cattle (Redbo, 1993) and in pigs (Beattie, Walker, & Sneddon, 1995)—little has been done on canine behavior. The early studies on canine genetics at Jackson Laboratory involved the effects of environment and handling on puppies within the sensitive period of the first 14 weeks (Freedman, King, & Elliot, 1961). The environments were either pens or total isolation from other dogs or humans (Fox & Stelzner, 1966).

The dogs spent little time on top of the shelter in the pens (< 2%) or on the tether (< 0.5%) in contrast to the findings of Hubrecht (1993) that dogs spent almost half their time on top of a platform. The difference in the enclosures probably explains this. The dogs in our study could see other dogs and any person in the area without having to be elevated; the dogs in the Hubrecht (1993) study had a restricted view.

Dogs spend a lot of time resting. Hubrecht (1995) found that dogs in shelters spent 62% to 85% of their time inactive, whereas laboratory dogs in pens were inactive 54% to 72% of the time. The highest percentages were found in singly housed dogs.

The behavior of the sled dogs is similar to those of the beagles in Hetts et al. (1992) and Hubrecht et al. (1992) studies and that of the large breed dogs in Crowell-Davis, Barry, Ballam, and Laflamme (1995). In all four studies, lying was the most common behavior in the afternoon; sitting occupied about 10% of the time. The sled dogs appeared to be more active, especially on the tether.

In each housing environment, the majority of the time was spent either lying or sitting. In observing the general activity and specific behaviors of adult sled dogs, Delude (1986) reported that the dogs who were kept in an enclosed yard within which they were individually tethered spent most of the day and night in a recumbent posture doing little and that this inactivity was independent of ambient temperature. He found that activity of sled dogs, including sitting, standing, and moving, began to increase about 2 hr before sunrise, reached a peak shortly after sunrise, and then declined. He also found that a second activity peak of equal intensity began in the late afternoon, peaked about 1.5 hr before sunset, and then declined rapidly. When compared to the data collected by Delude, the dogs who were observed in our study had less recumbent time. Delude noted that male dogs were more active than female dogs; in our study, male dogs were more active than female dogs in the pen, and female dogs were more active than male dogs on the tether. There were no consistent sex differences among the studies or housing conditions.

Stereotypic behaviors are often considered an animal welfare indicator (Broom & Johnson, 1993). Hubrecht (1993) said increased opportunities for social contact and the provision of toys did little to prevent the development of stereotypic behavior or maintain the dog's interest while within the pen, despite the fact that the dogs were more active, played with toys, and used the platforms provided as enrichment. Although Hughes and Campbell (1989) found that pairing dogs decreased activity, Hubrecht (1995) found that group housed dogs were more active than singly housed ones. In our study, the dogs on the tether infrequently pulled on their collars; that is, they had taut chains when in playing and aggressive situations or when environmental stimuli such as squirrels or passersby were present. The infrequency may indicate that they were seldom frustrated by the restraint. Because they had been on tethers for several years at the time of the study, there is the possibility that the dogs initially tried to escape by pulling on their tethers but learned that it was ineffective. Because dogs circled in some situations that were not considered stressful but rather were considered playing or greeting, circling on a tether may not always be stereotypic. In the pen, there was more pacing and barking than on the tether. The fact that neither pens nor tethers are unacceptable environments for dogs is indicated by the lack of abnormal behaviors despite years of tethering. This is in contrast to the findings that caged beagles exhibited more abnormal behaviors as confinement time increased to months (Clark et al., 1997).

In our study, frequency of vocalization was greater in the pen (2.34%) than on the tether (0.83%) but was not significant because one dog contributed most of the barking. Barking, when not in response to another dog's bark, may be stereotypic and a sign of frustration (Adams & Johnson, 1994). Hubrecht (1993) suggested that increased time spent standing on the hind legs may be an indication of the dog's interest in events outside the pen and could be suggestive of boredom. In our study, standing on the hind legs was significantly increased in the pen, possibly because standing with their forelegs against the gate to the pen was less stressful than using the taut chain to keep them balanced while standing on their hind legs when tethered.

## CONCLUSIONS

In each housing environment, whether tethered or in a pen, sled dogs spent the majority of their time either lying or sitting. They had more opportunity for interaction with one another in the pen, but less space. Stereotypic pacing in the pens occurred more frequently than circling on the tether. There was no indication that tethering was more detrimental to the dogs' welfare than housing in a pen.

Although tethering is intuitively less acceptable, the fact that the dogs rarely pulled at their chains and the lack of major differences in behavior indicate that tethering may be an acceptable alternative housing method, but this may depend on the breed and experience of the dog. Our findings provide no evidence that teth-

ering was any more or less detrimental to dog welfare than being housed in pens (as recommended by the USDA). Definite recommendations regarding the use of pens and tethers require further experimental trials in which environmental and prior experience can be better controlled than in this study.

## REFERENCES

- Adams, G. J., & Johnson, K. G. (1994). Behavioral responses to barking and other auditory stimuli during night-time sleeping and waking in the domestic dog (*Canis familiaris*). *Applied Animal Behaviour Science*, *39*, 151–162.
- Animal and Plant Health Inspection Service. (1997). *Humane treatment of dogs and cats: Tethering and temperature requirements*. Riverdale, MD: Department of Agriculture, Animal and Plant Health Inspection Service.
- Beattie, V. E., Walker, N., & Sneddon, I. A. (1995). Effect of rearing environment and change of environment on the behaviour of gilts. *Applied Animal Behaviour Science*, *46*, 57–65.
- Broom, D. M., & Johnson, K. G. (1993). *Stress and animal welfare*. London: Chapman & Hall.
- Campbell, S. A., Hughes, H. C., Griffin, H. E., Landi, M. S., & Mallon, F. M. (1988). Some effects of limited exercise on purpose-bred beagles. *American Journal of Veterinary Research*, *49*, 1298–1301.
- Clark, J. D., Calpin, B. S., & Armstrong, R. B. (1991). Influence of type of enclosure on exercise fitness of dogs. *American Journal of Veterinary Research*, *52*, 1024–1028.
- Clark, J. D., Rager, D. R., Crowell-Davis, S., & Evans, D. L. (1997). Housing and exercise of dogs: Effects on behavior, immune function, and cortisol concentration. *Laboratory Animal Science*, *47*, 500–510.
- Crowell-Davis, S. L., Barry, K., Ballam, J. M., & Laflamme, D. P. (1995). The effect of caloric restriction on the behavior of pen-housed dogs: Transition from unrestricted to restricted diet. *Applied Animal Behavior Science*, *43*, 27–41.
- Delude, L. A. (1986). Activity patterns and behavior of sled dogs. *Applied Animal Behavior Science*, *15*, 161–168.
- Fox, M. W., & Stelzner, D. (1966). Approach/withdrawal variables in the development of social behaviour in the dog. *Animal Behaviour*, *14*, 362–366.
- Freedman, D. G., King, J. A., & Elliot, E. (1961). Critical period in the social development of dogs. *Science*, *133*, 1016–1017.
- Hetts, S., Clark, J. D., Calpin, J. P., Arnold, C. E., & Mateo, J. M. (1992). Influence of housing conditions on beagle behavior. *Applied Animal Behavior Science*, *34*, 137–155.
- Hite, M., Hanson, H. M., Bohidar, N. R., Conti, P. A., & Mattis, P. A. (1977). Effect of cage size on patterns of activity and health of beagle dogs. *Laboratory Animal Science*, *27*, 60–64.
- Hubrecht, R. C. (1993). A comparison of social and environmental enrichment methods for laboratory housed dogs. *Applied Animal Behavior Science*, *37*, 345–361.
- Hubrecht, R. C. (1995). The welfare of dogs in human care. In J. Serpell (Ed.), *The domestic dog, its evolution, behavior and interactions with people* (pp. 179–198). Cambridge, England: Cambridge University Press.
- Hubrecht, R. C., Serpell, J. A., & Poole, T. B. (1992). Correlates of pen size and housing conditions on the behavior of kennel dogs. *Applied Animal Behavior Science*, *34*, 365–383.
- Hughes, H. C., & Campbell, S. A. (1989). Effect of primary enclosure size and human contact. In J. Mench & L. Krulisch (Eds.), *Canine research environment* (pp. 66–73). Bethesda, MD: Scientists Center for Animal Welfare.

- Mench, J. A., & Mason, G. J. (1997). Behavior. In M. C. Appleby & B. O. Hughes (Eds.), *Animal welfare* (pp. 127–141). New York: CAB.
- Newton, W. M. (1972). An evaluation of the effect of various degrees of long-term confinement on adult beagle dogs. *Laboratory Animal Science*, 22, 860–864.
- Redbo, I. (1993) Stereotypies and cortisol secretion in heifers subjected to tethering. *Applied Animal Behaviour Science*, 38, 213–225.