Search and identification methods that owners use to find a lost dog

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Objective—To characterize the process by which owners search for lost dogs and identify factors associated with time to recovery.

Design—Cross-sectional study.

Sample Population—Owners of 187 dogs lost in Montgomery County, Ohio, between June 1 and September 30, 2005.

Procedures—A telephone survey was conducted.

Results—132 of the 187 (71%) dogs were recovered; median time to recovery was 2 days (range, 0.5 to 21 days). Dogs were recovered primarily through a call or visit to an animal agency (46 [34.8%]), a dog license tag (24 [18.2%]), and posting of neighborhood signs (20 [15.2%]). Eighty-nine (48%) dogs had some type of identification at the time they were lost (ie, identification tag, dog license tag, rabies tag, or microchip). Owners had a higher likelihood of recovery when they called an animal agency (hazard ratio, 2.1), visited an animal agency (1.8), and posted neighborhood signs. Dogs that were wearing a dog license tag also had a higher likelihood of recovery (hazard ratio, 1.6). Owners were less likely to recover their dogs if they believed their dogs were stolen (hazard ratio, 0.3).

Conclusions and Clinical Relevance—Results suggest that various factors are associated with the likelihood that owners will recover a lost dog. Both animal agencies and veterinarians can play a role in educating dog owners on the importance of identification tags, licensing, and microchips and can help to emphasize the importance of having a search plan in case a dog is lost. (*J Am Vet Med Assoc* 2007;230:211–216)

Dogs and cats are enormously popular as companion animals in the United States. In 2002, it was estimated that 36% of American households owned dogs and 32% of American households owned cats.[1] Not only are dogs and cats popular, but their owners consider them part of the family. In the 2004 American Animal Hospital Association Pet Survey, 50% of respondents indicated they would choose a dog or cat as their sole companion if stranded on a desert island, and 56% said they would be very likely to risk their lives to save their pets.[2]

A pet that strays from its home can be at serious risk for starvation, injury, or death. Also, given the strength of the human-animal bond and the emotional attachment that many owners have to their pets, having a pet stray from its home can be traumatic and distressing for the owner. Thus, veterinarians may provide a benefit to both their patients and their clients by counseling pet owners on methods to prevent lost pets and effective means to ensure the rapid recovery of pets that do become lost. Traditionally, owners have identified their pets with tags on the pets' collars and have placed advertisements in newspapers or searched local animal shelters to recover lost pets. Newer technology has led to the use of implanted microchip identification methods and Web sites devoted to finding and returning lost pets to their owners. However, the effectiveness of the various methods available for recovering lost pets has not been reported. The purposes of the study reported here were to characterize the process by which owners search for lost dogs and identify factors associated with time to recovery of lost dogs.

Materials and Methods

Location of study—The study was conducted in Montgomery County, Ohio, during 2005. At the time of the study, the county had approximately 550,000 residents,[3] of which 160,000 resided in the city of Dayton,[4] and a single major newspaper, the *Dayton Daily News*. At that time, each county in Ohio had a primary dog warden who was responsible for handling stray dogs,[5] and dogs were required to wear a county dog license tag. The license tag had a number by which the county dog warden could identify the owner of the dog, and the county dog warden was required to hold all unlicensed stray dogs for 3 days and all licensed stray dogs for 14 days. Three major animal care and control agencies operated in Montgomery County at the time of the study: a dog warden agency that handled all stray dogs for the county as well as stray cats for some city municipalities, and 2 nonprofit humane societies that handled cats and owner-surrendered dogs and received reports

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on lost dogs. Combined, these 3 agencies handled approximately 7,400 dogs during 2005; the return-to-owner rate at the county dog warden facility during the year was 19%. All 3 agencies scanned incoming dogs for microchips and implanted microchips in any dogs adopted from the agency.

Study population—The study population consisted of a cohort of dogs that had been identified as missing by their owners through placement of an advertisement in the lost-and-found portion of the classified section in the *Dayton Daily News* or through contact with 1 of the county's 3 animal agencies between June 1, 2005, and September 30, 2005. The primary phone number given by the owner was used as a unique identifier to avoid including any individual lost dog that had been reported missing in multiple sources more than once in the study.

Sampling frame—Each animal agency kept a log of the phone number and date of contact for any owner who contacted the agency regarding a lost dog. Additional information such as date the dog was lost, area of town where the dog was lost, and signalment (ie, sex, breed, and age) of the lost dog was provided to the agency at the owner's option. Information in newspaper advertisements varied but typically included the owner's phone number, breed of dog, date the dog was lost, area of town, and whether a reward was offered.

For the present study, newspaper advertisements regarding lost dogs were collected daily and animal agency logs were collected monthly during the study period. A separate sampling frame was created for each of the 4 months in the study (ie, June, July, August, and September 2005).

Sample selection—At the end of each month, a random-numbers table was used to select a simple random sample of 35% of dogs lost during that month for inclusion in the present study. The percentage of dogs selected each month was determined on the basis of sample size calculations obtained from a pilot study.

Study design—A cross-sectional study incorporating a telephone survey was performed. A standardized survey method was used.[6] Owners were contacted no sooner than 30 days after the date the dog was lost. If the date the dog was lost was unavailable, the owner was contacted no sooner than 30 days after the date of contact by the owner with the animal agency or the starting date of the newspaper advertisement. This time frame was chosen to provide ample time for dog recovery without excessive risk of recall bias. Owners were contacted 10 times before they were considered a nonresponse. Owners with disconnected phone numbers were treated as a nonresponse only if the phone number was generated from a call to an animal agency, instead of having been obtained from a written log. Owners were excluded from the study if they reported they had visited the animal agency for any reason other than looking for a lost dog (eg, looking for a dog to adopt or visiting a dog being held in quarantine because of a bite).

Pilot study—A pilot study involving dogs lost during May 2005 was performed to estimate the percentage of lost dogs that would be recovered by their owners. This percentage was then used for sample size calculations.[7] Owners of 23 of the 192 dogs lost during May were interviewed. Of the 23 dogs that had been lost, 17 (74%) were recovered by their owners. The pilot study was also used to test the reliability of the questionnaire; each question was tested for reliability with the kappa statistic or Spearman reliability statistic. Validity of some of the information was measured during the pilot study by comparing answers to signalment questions with the information reported to the animal agencies. In all instances, the information was the same.

Telephone questionnaire—Owners were asked a series of questions related to recovery of their dog, characteristics of the dog, methods of identification on the dog at the time the dog was lost, methods used to search for the dog, and other miscellaneous information.[a] Questions related to recovery of the dog concerned how the dog was reunited with the owner (ie, dog returned home on its own, personal identification tag, dog license tag, rabies tag, microchip, neighborhood signs, newspaper advertisement, call or visit to animal agency, and other) and distance the dog had traveled from home (ie, returned home on own, < 1 mile, 1 to 5 miles, or > 5 miles). Questions related to characteristics of the dog included sex of the dog, whether the dog was purebred (yes or no), age of the dog (≤ 1 year, > 1 but < 5 years, or ≥ 5 years), how long the dog had been owned (≤ 1 year, > 1 but < 5 years, or ≥ 5 years), neuter status of the dog (spayed or sexually intact), and number of times the dog had been lost in the past (never, 1 to 5 times, or > 5 times). Questions related to methods of identification on the dog at the time the dog was lost were all yes-no questions regarding the presence of a personal identification tag, dog license tag, rabies tag, and microchip. Questions related to search methods included whether the owner had placed an advertisement in the newspaper (yes vs no, with starting and ending date of advertisement if yes), had read the newspaper to look for advertisements announcing dogs that had been found (yes vs no), had called an animal agency (yes vs no, with date of first call if yes), had visited an animal agency (yes vs no, with number of visits, starting and ending date of visits, and number of agencies visited if yes), had placed signs in the neighborhood (yes vs no), had searched Web sites involving lost pets (yes vs no), or had used other search methods (yes vs no). Miscellaneous questions included whether the owner believed the dog had been stolen (yes vs no) and whether the owner had offered a reward for the dog (yes vs no). All data were tracked with standard database software.[b] The survey was given exempt approval status by The Ohio State University Institutional Review Board.

Statistical analysis—Medians and ranges were calculated for responses that consisted of continuous data, and proportions were calculated for responses that consisted of categorical data. For each of the search and identification methods, the success rate was calculated as the number of dogs recovered by use of that method divided by the number of owners who used that search method or by the number of dogs

with the corresponding identification method. Dogs that returned home on their own and dogs for which the recovery method was listed as other were excluded from calculation of success rates.

One of the major outcomes of interest for the study was time to recovery of lost dogs. Because this outcome represented time to an event, right censoring was accounted for by use of a categorical variable for recovery of the dog (1 = yes; 0 = no), and survival analysis methods[8] were used to analyze the data. Standard statistical software[c] was used for all analyses. Univariate Cox proportional hazards regression model analyses were performed to screen variables for subsequent inclusion in multivariate analysis. Variables with values of $P \leq 0.25$ in these univariate analyses were included in the multivariate analysis. Variables were removed from the full multivariate model on the basis of results of the likelihood ratio test. Biologically meaningful interactions between the main effect variables in the model were tested for inclusion in a similar manner.

Before the model-building process, the proportional hazards assumption was tested on each variable by means of Schoenfeld residuals and graphic techniques to determine whether the log hazard ratio function was constant over time.[9] For variables that did not satisfy the assumption, the interaction between the variable and the logarithm of time was included in the model. After the model-building process, the assumption of proportional hazards was again tested for each variable included in the final model. Variables that included a date component were treated as time-varying covariates. For all statistical tests, a value of $P \leq 0.05$ was considered significant.

Results

During the study period, 823 dogs were identified as lost, and owners of 294 of these dogs were randomly selected for possible inclusion in the study. Of these, 263 owners were determined to be eligible for the study, and 187 (71%) agreed to complete a telephone interview.

Recovery of dogs—Of the 187 lost dogs included in the study, 132 (71%) were recovered. Median time to recovery for dogs that were recovered was 2 days (range, 0.5 to 21 days). Recovery methods categorized by time the dog had been lost were summarized (**Table 1**). For 124 of the 132 dogs that were recovered, the owner reported how far from home the dog was found. Ten of the 124 (8%) returned home on their own, 88 (71%) were found < 1 mile from home, 17 (14%) were found 1 to 5 miles from home, and 9 (7%) were found > 5 miles from home.

Dog characteristics—Of the 187 dogs that were lost, 116 (62%) were male and 71 (38%) were female. Owners reported 117 (63%) were purebred and 70 (37%) were of mixed breeding. Overall, 87 (53%) of the dogs were neutered and 100 (47%) were sexually intact, with comparable percentages for males and females. Forty-seven (25%) dogs were ≤ 1 year old, 75 (40%) were > 1 but < 5 years old, and 65 (35%) were ≥ 5 years old. Sixty-two (33%) dogs had been owned ≤ 1 year, 67 (36%) had been owned > 1 but < 5 years, and 58 (31%) had been owned ≥ 5 years. Owners reported that 101 (54%) of the dogs had never been lost previously, 53 (28%) had been lost 1 to 5 times previously, and 33 (18%) had been lost > 5 times previously.

Identification and search methods—Thirty-six of the 187 (19%) dogs reportedly were wearing a personal identification tag at the time they were lost, 75 (41%) were wearing a dog license tag, 37 (20%) were wearing a rabies tag, and 15 (8%) had a microchip. Overall, 81 (43%) dogs were wearing 1 or more of the 3 types of tags, and 89 (48%) had some form of identification at the time they were lost. Seventy of the 132 (53%) dogs that were recovered had some form of identification when lost, compared with only 19 of the 55 (35%) dogs that were not recovered. Success rates for the types of identification, defined as the percentage of dogs having the identification that were recovered by means of that identification method, were 32% (24/76 dogs) for the dog license tag, 31% (11/36 dogs) for the personal identification tag, and 13% (2/15 dogs) for the microchip.

Search methods used by owners were categorized on the basis of time the dog had been lost (**Table 2**). The dog was recovered by 46 of the 165 (28%) owners who either called or visited an animal agency, 20 of 75 (27%) owners who posted signs in the neighborhood, and 6 of 26 (23%) owners who placed an advertisement in the newspaper.

Overall, 165 owners called, visited, or both called and visited an animal agency in regard to their lost dog. Median time to call or visit an animal agency was 1 day (range, 0 to 14 days). Median time to call or visit an

Table 1—Methods by which 132 dogs lost in Montgomery County, Ohio, between June 1 and September 30, 2005, were recovered by their owners.

	Time dog was lost (d)			
Recovery method	**≤ 1**	**> 1 but < 5**	**≥ 5**	**Total**
Dog came home on its own	5 (8.8)	2 (4.9)	3 (8.8)	**10 (7.6)**
Identification tag	7 (12.3)	3 (7.3)	1 (3.0)	**11 (8.3)**
Dog license tag	15 (26.3)	6 (14.7)	3 (8.8)	**24 (18.2)**
Microchip	1 (1.8)	1 (2.4)	0 (0)	**2 (1.5)**
Neighborhood signs	6 (10.5)	6 (14.7)	8 (23.5)	**20 (15.2)**
Newspaper advertisement	0 (0)	1 (2.4)	5 (14.7)	**6 (4.5)**
Call or visit to animal agency	17 (29.8)	21 (51.2)	8 (23.5)	**46 (34.8)**
Other	6 (10.5)	1 (2.4)	6 (17.7)	**13 (9.8)**
Total	**57 (100)**	**41 (100)**	**34 (100)**	**132 (99.9)**

Values are given as number of dogs (%).

Table 2—Search methods used by owners of 187 dogs that were lost in Montgomery County, Ohio, between June 1 and September 30, 2005.

Search method	Dog recovered (d) ≤ 1 (n = 57)	> 1 but < 5 (n = 41)	≥ 5 (n = 34)	Dog not recovered (n = 55)	Total (n = 187)
Advertised in newspaper	4 (7.0)	1 (2.4)	10 (29.4)	11 (20.0)	**26 (13.9)**
Read newspaper	2 (3.5)	7 (17.1)	21 (61.8)	35 (63.6)	**65 (34.8)**
Searched Web sites	1 (1.8)	3 (7.3)	8 (23.5)	10 (18.2)	**22 (11.8)**
Called animal agency	34 (59.7)	26 (63.4)	32 (94.1)	51 (92.7)	**143 (76.5)**
Visited animal agency	29 (50.9)	33 (80.5)	28 (82.4)	49 (89.1)	**139 (74.3)**
Posted neighborhood signs	12 (21.1)	17 (41.5)	19 (55.9)	27 (49.1)	**75 (40.1)**
Other*	13 (22.8)	1 (2.4)	8 (23.5)	10 (18.2)	**32 (17.1)**

Values are given as number of owners (%).
*Other included contacting veterinarians, calling the police, and sending e-mail to neighbors.

Table 3—Results of multivariate Cox proportional hazards regression modeling for factors associated with recovery of a lost dog.

Variable	Hazard ratio (95% confidence interval)	*P* value
Visit animal agency	1.8 (1.12–2.74)	0.014
Call animal agency	2.1 (1.34–3.36)	0.001
Wearing dog license tag when lost	1.6 (1.14–2.30)	0.007
Owner believed dog was stolen	0.3 (0.15–0.76)	0.009
Interaction of placing neighborhood signs and ln [time]		0.012
Day 1	0.37	
Day 5	0.84	
Day 7	1.00	
Day 15	1.48	

The factors "visit animal agency" and "call animal agency" were included as time-varying covariates.

animal agency for owners who recovered their dogs was 1 day (range, 0 to 12 days), whereas median time to call or visit an animal agency for owners who did not recover their dogs was 2 days (range, 0 to 14 days). For owners that visited an animal agency more than once, median time between visits was 3 days (range, 0.5 to 47 days), but the median time for owners who recovered their dogs was 2 days (range, 0.5 to 14 days), whereas the median time for owners who did not recover their dogs was 17.5 days (range, 3 to 47 days).

Other characteristics—Thirty-nine of the 187 (21%) owners offered a reward for the return of their dog. Eighteen (10%) owners believed their dog was stolen. There were no significant differences in the frequencies with which various search methods were used between owners who believed their dogs were stolen and owners who did not.

Factors associated with recovery—When all 187 dogs were included in survival analyses, median recovery time was 4 days (95% confidence interval for median recovery time, 3 to 6 days). The factor "posting signs in the neighborhood" was found to violate the proportional hazards assumption; therefore, a term for the interaction between posting signs and the logarithm of time was included in the model. This was the only factor that was found to violate the proportional hazards assumption. The factors "placed an advertisement in the newspaper," "called an animal agency," and "visited an animal agency" were treated as time-varying covariates because information on dates when owners used these methods was obtained. The final multivariate model (**Table 3**) indicated that owners were significantly more likely to recover their lost dogs when they called an animal agency, visited an animal agency, and posted signs in the neighborhood. However, posting signs in the neighborhood did not become effective (ie, hazard ratio > 1.0) until after the dog had been lost for ≥ 7 days. Dogs that were wearing a dog license tag when lost were significantly more likely to be recovered. Dogs were significantly less likely to be recovered if their owners believed they were stolen.

Discussion

In the present study, a call or visit to an animal agency was reported as the method of recovery for 46 of the 132 (34.8%) lost dogs that were recovered, and for an additional 24 (18.2%), a dog license tag was reported as the method of recovery. In regression analyses, visiting an animal agency, calling an animal agency, and wearing a dog license tag were all associated with a significantly increased likelihood that a lost dog would be recovered, and owners who recovered their lost dogs visited or called an animal agency sooner and more frequently than did owners who did not recover their dogs. All of these findings support the concept that the animal control system was an important component in recovery of lost dogs when used by owners.

Even though the population of dogs included in the present study was such that owners considered the dogs important enough to attempt to find them when they were lost, only 89 of the 187 (48%) dogs had some form of identification on them at the time they were lost. Despite the legal requirement that dogs in Ohio be licensed, only 75 (41%) were wearing a dog license tag

at the time they were lost, and unofficial estimates suggest that only about 54% of dogs in Montgomery County are licensed. Only 36 of the 187 (19%) dogs in the present study were reported to be wearing a personal identification tag at the time they were lost. It was difficult to measure what effect wearing a personal identification tag had on recovery of lost dogs because 32 of these 36 (89%) dogs were also wearing a dog license tag. Nevertheless, we believe that both of these identification methods are critical to the recovery of lost dogs and contribute to faster recovery. In the present study, the search and identification methods with the highest success rates were wearing a dog license tag and wearing a personal identification tag.

Only 15 of the 187 (8%) dogs in the present study had a microchip at the time they were lost, which is consistent with national estimates of the prevalence of microchipping in dogs,[10] and the success rate associated with microchips (13%) was the lowest rate for the search and identification methods used. One of the largest microchip manufacturers, Schering Plough, has estimated that of the 3.4 million pets with their microchips, 8% have been recovered through use of the microchip at some point in their lives.[11] With the increasing attention on pet reunification following Hurricane Katrina in 2005, we expect the prevalence of microchips to increase. However, we do not believe that microchips should be viewed as a replacement for a personal identification tag or dog license tag for identification. Of the 15 dogs that had a microchip in the present study, only 7 were wearing some type of identification tag. It is our belief that people who find a lost dog can locate the owner faster and more easily through the use of a tag than through the use of a microchip. Microchips, however, are important as a permanent method of identification and work as a backup for dogs that lose their collars and tags.

Placement of signs in the neighborhood was significantly associated with an increased likelihood of recovering a lost dog in the final model in the present study. However, the likelihood of recovery was significantly increased only for dogs that had been lost ≥ 7 days. This was most likely due to the fact that the number of owners who placed signs in the neighborhood increased as the time dogs were lost increased. For instance, only 29 of 98 (30%) owners whose dogs had been lost < 5 days placed signs in the neighborhood, whereas 46 of 89 (52%) owners whose dogs had been lost ≥ 5 days placed signs in the neighborhood. Of the 34 dogs recovered after ≥ 5 days, 8 (23.5%) were recovered because of signs placed in the neighborhood. Given that only 26 of 124 (21%) dogs for which distance from home was reported were recovered ≥ 1 mile from home, it appears that owners would be most successful in posting neighborhood signs close to their home.

Although placing an advertisement in the newspaper was not significantly associated with the likelihood of recovery of a lost dog in the present study, we believe that this is an important method that is underused. Only 26 of the 187 (13.9%) owners in the present study reported having advertised in the newspaper, and although only 6 of the 132 (4.5%) dogs that were recovered were reportedly recovered because of a newspaper advertisement, the success rate for placing an advertisement in the newspaper was 23%. Owners also did not tend to read the newspaper for advertisements describing stray dogs that had been found, in that only 65 of the 187 (34.8%) owners reported using this search method. We believe that improving awareness of the lost-and-found section of the classified advertisements in the newspaper may increase the percentage of owners who use this method. It may be, however, that the cost of placing an advertisement is an important barrier for many owners.

Use of Web sites was infrequent in our sample population, with only 22 of the 187 (11.8%) owners reporting that they searched Web sites involving lost pets for information about their lost dog. Multiple national lost-and-found Web sites have been developed to assist owners in locating lost pets. However, our results suggest that most pet owners are not aware of these sites or do not have access to them. Anecdotally, several owners reported during the telephone interview process that they did not own a computer or did not have access to the Internet, suggesting that lack of access was a problem. It has been estimated, however, that 69% of the US population has recently used the Internet,[12] making it likely that a lack of awareness of lost-and-found Web sites is more of a barrier to their use.

In the present study, owners who believed their dogs were stolen were significantly less likely to recover them than were dog owners who did not have this belief. We originally hypothesized that owners who believed their dogs were stolen would not search as diligently as owners who did not share this belief. We did not find this to be true, as there were no differences in how these owners searched for their dogs. Although it is impossible to know whether these dogs were truly stolen, the belief was associated with a lower likelihood of recovery.

There are several limitations associated with the present study. We chose to include only those owners who made some initial attempt to find their lost dogs by placing an advertisement in the local newspaper or calling or visiting an animal control agency. Thus, we were unable to interview owners who had lost a dog but did not place an advertisement or call or visit an animal agency as part of their search efforts. We believe that further research is warranted to identify and interview these owners to understand what search methods they use, if any. As with any study that focuses on a particular geographic area, care should be taken in extrapolating results of the present study to the situation in other areas. Finally, because data were collected for only 4 months of the year, it is possible that seasonal differences exist for search and recovery methods.

To the best of our knowledge, the present study is the first to show that most owners who make an effort to recover their lost dogs are able to do so. Furthermore, our study illustrates that there is a need for education of owners on the various search methods available and the importance of identification. One hundred one of the 187 (54%) dogs in the present study had reportedly never been lost previously, suggesting that many owners were likely inexperienced in how to search for a lost dog. In addition, given that

only 89 of the 187 (48%) dogs had some identification at the time they were lost, an opportunity exists for increasing awareness of the importance of identification. Both animal agencies and veterinarians can play a role in educating dog owners on the importance of identification tags, licensing, and microchips and can help to emphasize the importance of having a search plan in case a dog is lost.

a. Copies of the telephone survey are available from the corresponding author on request.
b. Microsoft Office Access 2003, Microsoft Corp, Redmond, Wash.
c. Stata, version 9.1, StataCorp, College Station, Tex.

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