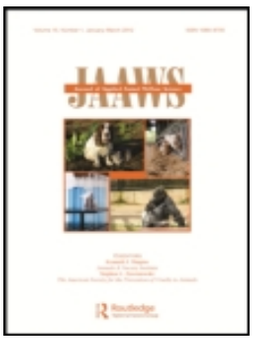

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Characteristics of Owned Dogs on the Island of New Providence, The Bahamas

William J. Fielding and Susan J. Plumridge
The College of the Bahamas

This study reports the findings from street interviews on owned dogs (N = 442) in New Providence, The Bahamas. Many households kept dogs outside, and roughly 43% of households allowed at least 1 dog to roam. Dogs kept inside most likely were considered a companion, whereas dogs used for security were kept outside. With 36.1% of the dog population neutered and 4.4 puppies per litter surviving to breeding age (6 months), the population continues to produce more dogs than are required just to maintain its numbers. Potcakes, the local mongrel, followed by pit bulls, were the most commonly kept dogs. Comparison with a study conducted in the Yucatan, Mexico (A. Ortega-Pacheco et al., 2005), suggests that the hostile subtropical environment of New Providence well may be responsible for checking the growth of the dog population. The study also suggests that until less than 20% of the females breed, there will continue to be a dog problem on the island.

Dog ownership has a long history in New Providence, The Bahamas; the presence of dogs dates back to the arrival of Columbus. By the 1850s, roaming dogs were regarded as a nuisance, and the first of a series of dog license laws designed to curb dog ownership were passed. Despite these measures, dogs continued to be a bother throughout the 19th and 20th centuries. At the beginning of the 21st century, the level of care offered pets and the consequent numbers of roaming/unowned dogs continue to be an issue. This concern is heightened by the fact that tourists can be upset by seeing potcakes (local mongrel dogs) roaming the streets of New Providence (Fielding, Mather, & Isaacs, 2005). Furthermore, the presence of roaming dogs may project a feeling of inner-city decay,

Correspondence should be sent to William J. Fielding, College of the Bahamas, Oakes Field Campus, P.O. Box N–4912, Nassau, New Providence, The Bahamas. Email: wfru@hotmail.com

drugs, and violence (Ross & Mirowsky, 1999) that is detrimental to a tourism-based economy.

Studies on the Bahamian dog population, starting in 1998 (Fielding & Mather, 2001), used data from various sources in an attempt to characterize dog care practices and describe the owned population. The findings focused attention on a low neutering rate; the lack of confinement; and the willingness to abandon, or give away, unwanted dogs—all aspects that are likely to contribute to the number of dogs roaming the streets of New Providence. Only one study, based on a small number of companion animals on the neighboring island of Abaco, has attempted to assess the breeding potential of the owned-dog population (Humane Society International, 2001). One important observation emerging from that study was that all litters reported on had been born to animals who had been allowed to roam—suggesting the lack of controlled breeding.

Most dogs reportedly are kept for protection, but it is not known whether this means as a watchdog—a dog who barks but may not bite—or a guard dog—a dog who may not bark but would attack an intruder (Fielding et al., 2005). This distinction may be important. A survey of college students was divided as to whether it was acceptable for people to have dogs who can kill intruders (Burrows & Fielding, 2005). In addition, some guard dogs who are trained to be aggressive may roam (Fielding & Plumridge, 2004) and pose a real danger to society; however, the popularity of such potentially dangerous dogs currently is not known.

Although previous studies have sought to infer the composition of the owned dog population (Fielding et al., 2005), no large-scale study has attempted directly to examine the popularity of owned breeds. The study conducted in Abaco suggested that Labradors were the most popular breed (Humane Society International, 2001); veterinarians have suggested that pit bulls are most common in New Providence (Fielding et al., 2005). Registration records from the Bahamas Kennel Club (which does not recognize pit bulls as a breed) suggest that German Shepherds may be the most popular breed. However, because only a small number of dogs are registered by the club (Fielding et al., 2005), and only a particular type of owner is likely to register dogs, these figures may not represent the wider dog population. It is apparent that stakeholders in animal control and animal welfare still require a great deal of key information to focus policies appropriately.

Dog care throughout the Caribbean is a cause for concern. This has resulted in several groups—including The Pegasus Foundation and Humane Society International—taking an interest in the region through funding animal control programs and organizing conferences (The Pegasus Foundation, 2004). It appears that neutering programs are the most common tactic used by animal welfare groups for controlling dog populations (Fielding, 2004). Although neutering can reduce the number of unwanted animals (Frank & Carlisle-Frank, 2005), it yet is to be determined whether sufficient resources can be used to make many local neutering programs successful. In addition, Caribbean animal welfare groups share many

common challenges—including a paucity of information about the dog populations—that highlight the importance of studies on Caribbean dog populations.

Almost all information on roaming dogs (Beck, 1973/2001) and breed dog dynamics (National Canine Breed Health Surveys, 2000; New et al., 2004) seem to relate to developed countries; less data are available regarding owned-dog populations in subtropical climates where many dogs are allowed to roam (Matter & Daniels, 2000; Ortega-Pacheco et al., 2005; Romney, 2004).

This study was undertaken to provide a description of "owned" dogs by gathering information on a large sample of dogs owned by the public in New Providence. For the purposes of this study, *owned dogs* are those whom people claim to own, not those whom caregivers legally may own. This distinction is legally important because almost no people in The Bahamas license their dogs. However, the law confers ownership if a dog spends most of his or her time on a person's property (Fielding et at., 2005). Claim of ownership is important for a dog because this may influence the level of care. It also is important for society because no one can be held accountable for the actions of dogs, even dangerous ones, who are unclaimed. To acquire a fuller appreciation of human–dog interaction, we also gathered information on the feeding of dogs unowned by respondents.

METHOD

A convenience sample targeted equal numbers of male and female adults from the general population—not just dog-carers—who were under and over 35 years of age. The age constraint was chosen to divide the sample into younger and older respondents because it is known that younger males in Bahamian society favor pit bulls (Burrows & Fielding, 2005). From the 2000 census, it is known that the Bahamian population of 303,611 (of whom 210,832 live on New Providence) is close to 50% male and 50% female (Department of Statistics, 2002). Students from The College of The Bahamas, who were trained in the classroom ahead of time, collected the information by interviewing residents on the streets in communities across the island of New Providence. Respondents in dog-keeping households were asked questions on the breeding characteristics of each dog in the household. Although convenience samples can produce biased results, it is a practical solution to sampling in a community that does not always welcome strangers who come to their homes and ask questions. Participation was promoted by limiting the survey to a small number of questions; this strategy was based on experience from previous studies and knowledge of the community.

Because of the personal nature of dog keeping in New Providence, unless the caregiver actually is interviewed, it is to be expected that other household members may have only a limited ability to answer questions about the dogs. Although interviews at veterinary clinics would increase the chances of interviewing the

carer, it is known that only a limited number of carers take their animals to the veterinarian (Fielding et al., 2005), so the results would not refer to the wider dog population. The respondent gave the breed/type information. Because this was a street survey, there was no opportunity to verify the description given. Mixes were counted separately because—although technically mongrels—they will display characteristics of the breeds, more so than the potcake, who has distinctive characteristics (Fielding et al., 2005). There probably is a stigma associated with pit bull ownership (Burrows & Fielding, 2005); consequently, respondents may have downplayed owning such dogs or couched their description to disguise them. When respondents indicated only that "all" the puppies survived, eight was used as the litter size (Humane Society of the United States, 2004a). When respondents did not know the number of puppies surviving, the average number surviving from this study was used in the calculations. The use of *adult* denotes dogs of breeding age. This age was set at 6 months or more; however, dogs who had bred before 6 months also were considered adult.

RESULTS

Four-hundred sixty-eight adults were interviewed, 47.4% males ($N = 222$) and 52.6 % female ($N = 246$). Of these, 49.6% were under 35 years of age ($N = 232$). Two hundred forty-four respondents provided information on 442 dogs, 19.1% of whom were 6 months old or younger.

Extent of and Reasons for Keeping Dogs

Dogs were cared for in 52.1% of the households of the 468 people interviewed. Overall, an average of 0.94 ($SE = 0.065$) dogs per household were reported, or 1.81 ($SE = 0.096$) dogs per dog-owning household. Dog-keeping was uneven across households, with 48% of households having no dog, and another 20% of households keeping 64% of the dogs. Security, either as guard dogs or watch-dogs, was the most common reason reported for households having dogs (see Table 1). Some respondents kept dogs as "companions," whereas others kept them as "pets." Almost 2% of the households bred dogs for sale, and 1 respondent did not know why the household kept dogs.

Demographics of the Dog Population

The mean age of all dogs was 2.58 years ($SE = 0.109$; 393 dogs); the mean age of adults was 3.07 years ($SE = 0.118$). The age distribution of the entire population is illustrated in Figure 1. This distribution is consistent with a survival rate of 65% from 1 year to the next, $\chi^2(n = 12)$, $p > .20$. Just over 57% of these dogs

TABLE 1
Primary Reasons for Keeping Dogs in New Providence

Reason for Keeping Dogs	*%*
Companion	47.0
Pet	0.4
Pet and guard dog	0.9
Guard dog	26.9
Watch dog	22.6
Sell	1.7
Just to have one	0.4

Note. $N = 234$.

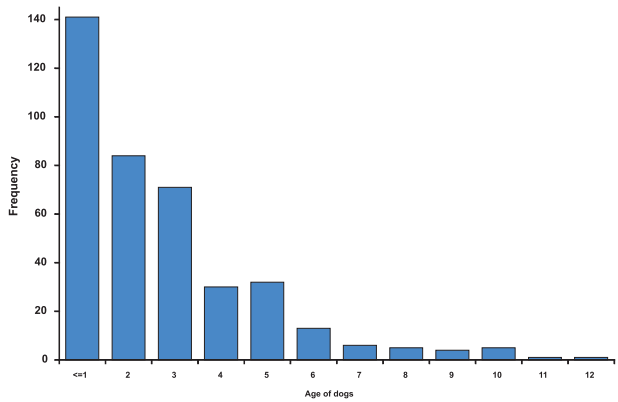

FIGURE 1 Age distribution of 393 owned dogs in New Providence, The Bahamas, 2005.

were 2 or younger, and just under 6 % were 7 or older; the median age was 2 years. On average, adults kept inside the home were older (3.17 years, SE = 0.141) than those kept outside the home (2.68 years, $SE = 0.230$; Mann–Whitney U test, $p = .019$, $n = 314$). There was no difference in the age of the adults by sex (Mann–Whitney U test, $p = .62$, $n = 318$) or breeding status (Mann–Whitney U test, $p = .94$, $n = 307$). More than half the dogs were males (53.8% of 437 dogs; the sex of 2 was not known by the respondent), but this did not show a real preference for male dogs (binomial test, $p = .103$, $n = 435$).

In the last 12 months, 57.8% of dog-caring households had taken at least one dog to the veterinarian. The breeds/types reported by respondents are listed in Table 2. One respondent did not know the breed of the dog in the household. The most commonly owned dog was the local mongrel, the potcake or potcake–breed mix, 30.5% ($n = 436$ dogs), followed by pit bulls, American bull dogs, bull terriers, and pit bull mixes (21.8%). In Table 3, "mixes" are attributed to the breed/type

TABLE 2
Popularity of Dog Breeds and Types in a Population of 436 Owned Dogs, 2005

Breed/Type	*%*	*% Total Assigned to Type*
Potcakes[a]	29.7	29.7
Pit bull types		21.3
American Bulldog	0.2	
Bull Terrier	0.5	
Pit bull	19.7	
Pit bull mix	0.9	
Chow-chow	7.8	9.4
Chow-chow mix	1.6	
Rottweiler	8.2	8.2
Poodle	5.7	5.7
Shih Tzu	5.3	5.5
Shih Tzu mix	0.2	
German Shepherd	5.0	5.2
German Shepherd mix	0.2	
Terriers		2.8
Fox Terrier	0.2	
Jack Russell	0.2	
Scottish Terrier	0.2	
Terrier	1.4	
Yorkshire Terrier	0.7	
Retrievers		2.6
Golden Retriever	0.5	
Labrador	1.4	
Labrador mix	0.7	
Pomeranian	2.3	2.3
Akita	0.5	1.2
Akita mix	0.7	
Bulldog	1.1	1.1
Bull Mastiff	0.7	0.7
Doberman	0.5	0.5
Dalmatian	0.5	0.5
St. Bernard	0.5	0.5
Collie	0.2	0.5
Collie mix	0.2	
Afghan hound	0.2	0.2
Beagle	0.2	0.2
Bichon Frise	0.2	0.2
Chihuahua	0.2	0.2
Cocker Spaniel	0.2	0.2
Irish Setter	0.2	0.2
Pug	0.2	0.2

Note. One dog's breed/type was not reported by the respondent. Figures have been rounded for clarity.

[a]Excludes mixes with potcakes (the local mongrel), these were included under breed mixes.

TABLE 3
Actual or Intended Fate of Dogs Not Wanted by Households

Fate of Unwanted Dogs	*%*
Give away	43.5
Hand to animal welfare group	28.3
Euthanize	12.6
"Leave in a safe place" (active abandonment)	3.0
"Let go" (passive abandonment)	2.6
Sell	2.6
"Just dies"	2.6
Shoot	1.7
Euthanize or give to animal welfare group	0.9
Give away or euthanize	0.9
Give away or give to animal welfare group	0.4
"Hand-in or leave in safe place"	0.4
Drown	0.4

Note. $N = 230$.

first stated by the respondent (Chow-Chow × pit bull mix would be attributed to Chow-Chows), except in the case of potcakes, where such mixes are assigned to the breed/type (a potcake × pit bull mix would be attributed to pit bulls). This was done to give a breed-based picture. It is clear, however, that the potcake mixes justifiably could be assigned to the potcake group, which then would have accounted for 30.5% of the dogs.

Almost all dogs were kept outside the home (73.0% of 429 dogs); 24.5% were kept inside. Female dogs were just as likely as males to be kept outside the home (Fisher's exact test, $p = .653$; $n = 423$). Adult dogs kept outside the home were less likely to be neutered (32.2% of 230 dogs) than those kept inside the home (45.5% of 77 dogs; Fisher's exact test, $p = .040$, $n = 307$). This observation helps to explain why dogs kept outside were more likely (46.5% of 101 dogs) to have had a litter than dogs kept inside (25.6% of 39 dogs; Fisher's exact test, $p = .018$, $n = 140$).

Overall, puppies (dogs under 0.5 years) and adults were just as likely to be kept outside the home (Fisher's exact test, $p = .449$, $n = 381$). However, smaller, adult dogs (terriers) were more likely to be kept inside the home than were larger dogs (potcakes, Chow-Chows). Only 3 of 30 smaller dogs were kept outside, compared with 231 of 284 larger dogs. During the previous month, 42.8% of dog-owning households (236 replies) had allowed 1 or more of their dogs on the street.

Information on Single-Dog-Owning Households

For brevity of the interview, some information was not asked for each dog. However, in the case of single-dog-owning households, information about a spe-

cific dog was obtained. Single dogs kept outside were more likely to gain access to the road (47.0% of 83 dogs) than single dogs kept inside the home (25.5% of 51 dogs; Fisher's exact test, $p = .017$, $n = 134$). When kept as a companion, 69.5% (48 of 69 replies) of single dogs were kept inside. Very few watchdogs (8.1%; 3 of 37 dogs), and none of the 24 guard dogs, were kept inside. Respondents from households with pit bulls, German Shepherds, and Rottweilers all indicated that their dogs roamed.

Breeding Ability of Owned Adult Dogs

Three dogs aged 6 months or less had bred, so these were counted as adult dogs. Of all adult dogs (310; the breeding status of another 11 was not known), 36.1% had been neutered. The neutering rate was similar for both males (33.3% of 165 dogs) and females (39.3% of 145 dogs; Fisher's exact test, $p = .288$; $n = 310$).

Of the female dogs, 40.6% (of 138) had bred in the previous 12 months, even though 63.0% (of 138) currently were intact. About half the intact females (51.7% of 87) had not bred in the previous 12 months. Of the currently spayed females, 27.5% (51) had had a litter in the previous 12 months, 13.9% of 101 females intact in the 12 months prior to the study had been spayed after having a litter. This points to carers' allowing females to have at least one litter before having them spayed.

The youngest age at which a dog bred was 6 months or less; the oldest age was 10 years. Of the currently intact females, those who had bred were significantly older (3.3 years, $SE = 0.28$) than those who had not (2.2 years, $SE = 0.28$; Mann–Whitney U test, $p < .001$, $n = 163$). A total of 18 % of dog-keeping households reported that their dogs had had at least 1 litter in the previous 12 months. The mean number of pups surviving to 6 months was 4.4 ($SE = 0.32$), with a median of 4 (65 litters) and a range of 0 to 10.

It should be noted that not all respondents knew how many pups had survived (a response of "all" or no figure was given), and some did not know if a dog had bred. Of the females whose breeding activity was reported ($n = 180$), an estimated 297 offspring survived to age 6 months (allowing for the unknown litter sizes), a ratio of 1.61 pups per female. No respondent indicated that any female had bred twice in the previous 12 months, so this litter size represents the total offspring per breeding female in 12 months. Multiple dogs kept by households were 3.6 times more likely to have had at least 1 litter in the previous 12 months than were dogs who were the only one in the household (odds ratio: 3.64; 95% confidence interval: 1.79, 7.43; $n = 226$).

Unwanted Animals

In the previous 12 months, 28.0% (236 replies) of households had dogs they did not want (had not been retained by the household). The most common way that

respondents indicated they would, or did, deal with excess animals was to give them away (43.5% of 230 replies); handing to an animal welfare group was indicated by 28.3% of respondents (see Table 3). Actions that could be regarded as inhumane (abandoning, killing) were indicated by 10.3% of respondents. The information on breeding, estimated mortality, and disposal was combined to obtain an estimate of the percentage growth of the dog population. The population growth was 48% (births – deaths); when migration and disposal are taken into account, the reproduction rate still could be more than 35%, the level at which the population would be in equilibrium (see Table 4). If it is agreed that the growth of the owned dog should be linked with the increase in the number of households to ensure an orderly increase in the dog population, it is clear that a surplus is being produced.

Actions Toward Animals Who Were "Unowned"

Respondents indicated that residents from 28.3% (of 460 replies) of households fed dogs. On average, 2.01 (SE = 0.175) dogs had been fed the previous day. This could amount to 230 dogs (allowing for respondents not always knowing how many dogs were fed), or 52.1% of the owned dog population. If it is assumed that each person fed 1 unique dog, the number of dogs fed would have been 130, or 29.4% of the owned-dog population. Members from non-dog-owning households were as likely to feed dogs they did not own as were those from dog-owning households (31.1% of 219 replies, compared to 25.7% of 241 replies; Fisher's exact test, n = 460, p = .215).

TABLE 4
Breeding and Estimated Mortality of Owned Dogs in New Providence

	%	*Total*	*Males*	*Females*
Opening dog population	100	468	251	217
Estimated number of dogs dying	35	–164		
No. of females breeding and producing an average of 4.4 puppies that survive to age 6 months	41	388		88
Estimated number of unwanted animals killed	44	–99		
Final population	127	593		

Note. Deaths are estimated from the age distribution depicted in Figure 1 and from responses listed in Table 4. If dog keepers do not replace their dogs who die, the surplus would be larger.

DISCUSSION

It should be noted that results from this study refer only to the participating households; extrapolation to the wider population should be done with caution as convenience samples are subject to bias. When noncarers were interviewed, it can be expected that the information might be less reliable than when the carer was the respondent. A lack of interest in household dogs was suggested as the reason why some respondents from dog-keeping households did not know the breeding status of the household dogs nor how many puppies had survived, or even if the dog had bred.

Age

The average age was in keeping with that reported before in The Bahamas and elsewhere in developing, warm-climate countries (Fielding et al., 2005); St. Maarten (Romney, 2004); and in the Yucatan, Mexico, which borders the Caribbean sea. Ortega-Pacheco et al. (2005) reported an average age of 3.09 years. The yearly loss of dogs of about 35% was higher than the previous estimate of 27% (Fielding & Mather, 2001). The limited veterinary care (57.8% of households had taken a dog to a clinic in the previous 12 months) and the presence of heartworm and canine distemper probably contribute to the low average age. The low age suggests a high turnover of dogs in the population which, in addition to keeping dogs outside, will prevent owners from establishing strong, companionable bonds with their pets.

Reasons for Dog Keeping

Problems associated with pet overpopulation may be attributed to a minority of society due to 20% of households keeping 64% of the owned dogs. As with other studies in the Caribbean (Fielding et al., 2005), St. Maarten (Romney, 2004), and elsewhere (Ortega-Pacheco et al., 2005), security was a dominant motivation for keeping dogs. The guarding and watching attributes were of almost equal importance.

Of interest is that some respondents made a distinction between their dog's being a *pet* and a *companion*. This indicates that the two words can have different meanings in this population. Therefore, they need to be defined and used with care. This is despite the fact that the attribute of "companion" often was considered to be one that a pet should have, according to college students (Fielding et al., 2005). Keeping dogs outside makes it harder for dogs and guardians to form bonds and, as in the case of single dogs, suggests that protection is the major reason why dogs are kept outside. Although few households kept dogs to breed puppies for sale, this activity should not be ignored; commercial breeding is unregulated, and the benefits

are considerable: Pit bull pups sell for $350 each as well as being the most commonly advertised dog for sale (Fielding et al., 2005).

Loose Dogs

This study suggests that more than half the households (52.1%) have dogs and that each dog-keeping household has an average of 1.81 dogs. The percentage of households indicating that their dogs could get on the road (about 40%) is comparable to that found in Baltimore (37%) in the 1970s in an owned but loose dog population (Beck, 1973/2001) and similar to the percentage of households with inadequate fences in Merida (37.5%; Ortega-Pacheco et al., 2005). One concern resulting from loose-owned dogs is that *pitcakes*, potcakes with pit bull features, also have become noticeable (Burrows, Fielding, & Mather, 2004). If this trend continues (the selection pressure maintained), physical changes in the potcake population can be expected to occur that may make them a danger to society.

Only 28% of respondents knew of anyone in their house who fed dogs they did not own. This may be a low estimate as respondents who did not feed dogs might know that other members of the household feed dogs only if they fed dogs at home. People providing handouts fed an average of 1.99 dogs the day before, or a population about half that of the owned population. Even if we assume that each person fed only 1 unique dog, this would represent almost 30% of the owned-dog population. Therefore, some of these dogs are likely to be loose-owned dogs as well as unowned dogs. This clearly represents considerable interaction between the loose dogs and humans—which is to be expected in a society sympathetic to roaming dogs (Fielding et al., 2005).

Breed Characteristics

Bahamian dog carers are more likely to keep small dogs than large ones inside the house. This also may account for dogs' being denied a place inside the home as they grow from puppies to adults (Mather & Fielding, 1999). It also is consistent with Bahamian case studies showing that household members can be fearful of having large dogs in close proximity to children (Fielding et al., 2005).

The breed/type information could not be verified, because the interview was not carried out in the respondents' homes. However, given that the information in Table 2 is not interpreted strictly in pure-breed terms, it probably gives a general idea of the composition of the owned-dog population. The breed/type characteristics of the owned population are in general agreement with those previously reported by veterinarian clinics. However, potcakes make up a smaller percentage of the owned population than suggested by Fielding et al. (2005) and local mongrels observed elsewhere (Ortega-Pacheco et al., 2005; Romney, 2004).

The choice of dog breeds/types (pit bulls, Chow-Chows, Rottweilers, and German Shepherds) is consistent with having dogs for security. It should be noted that the demand for the guarding ability of dogs was similar to that of watching ability, but a loose guard dog (pit bull) potentially is of greater risk to society than a loose watch dog (the potcake). The real threat of roaming pit bulls was observed in a fatal dog attack involving at least one loose pit bull in 2001 (Burrows et al., 2004). Elsewhere, the popular breeds in New Providence have been associated with a disproportionate number of fatal dog attacks and might be considered potentially dangerous (Sacks, Sinclair, Gilchrist, Golab, & Lockwood, 2000). Given that pit bulls and other guard dogs roam, the attitudes of society toward changes in legislation relating to dogs is of interest, with some 11% of interviewees not wanting changes in the laws relating to dogs (Fielding & Plumridge, 2005). Because animals kept outside the home are more likely than those kept inside the home to roam, it is of concern that watchdogs and guard dogs were most likely to be kept outside.

Although pit bulls are the breed of choice in several Caribbean islands (Fielding, 2004), the most popular breed in Merida was Maltese (14.1.%). In both New Providence and Merida, protection and protection/companion were the reasons for keeping dogs, given by 22.7% and 29.1% of respondents, respectively (Ortega-Pacheco et al., 2005). Dog keepers in New Providence, St. Maarten, and Mexico wanted dogs for protection, yet the choice of breed to achieve this goal appears different.

Breeding

The study confirms the hypothesis that relatively few pups survive to breed again in New Providence (Mather & Fielding, 1999). It also confirms the observation in Abaco of a low litter-survival rate, with fewer than one pup per litter per female in the population, surviving, based on the assumption of two litters a year. Despite the ability of dogs to breed twice a year (Humane Society of the United States, 2004a), this study revealed that no female appeared to have done this in the previous 12 months. The number of puppies surviving per litter to breeding age (6 months) was only about 4, which is low compared with other populations (Humane Society of the United States, 2004b; Purdue University, 2005). This figure may be low. Owners may have given away puppies who may have not survived to breeding age without the knowledge of the household of origin. However, even this rate of reproduction produces a sufficient number of unwanted dogs (from their household of birth) potentially to increase the roaming dog population through abandonment—both active and passive—as well as the giving away of animals to households that then may allow the dogs to roam.

The low neutering rate, together with the fact that dogs kept outside are less likely to be neutered than those kept inside, indicates the likelihood that roaming dogs potentially can mate and produce unwanted pups. The linkage between roam-

ing and breeding again can be seen by the fact that households with multiple dogs were only 3.6 times more likely to have had a litter compared with single-dog-owning households. In North America, however, where roaming is less common, multiple-dog households are 9.47 times more likely to have had a litter than are single-dog-owning households (New et al., 2004). It is clear that relatively few households contribute to the increase in the dog population. This may indicate a hardcore set of owners who may be reluctant to neuter their animals. On the basis of these data, we estimate that if the population is to reach equilibrium only 17% of females (as opposed to the observed 41%) should be allowed to breed per year (see Table 4). This observation is in agreement with Patronek and Rowan (1995) who found that only a few American households were responsible for sustaining the dog population.

Some owners appeared to spay their female dogs after they had bred. This is consistent with many carers in New Providence thinking that females should have a litter before they are spayed (Fielding, Samuels, & Mather, 2002). These data show the importance of educating these owners to act earlier to reduce the number of surplus puppies born. If these owners had acted earlier, the number of puppies born would have been reduced by about 10%.

It is informative to compare the breeding ability of the New Providence dog population with that in Merida. Although the neutering rate in New Providence is much higher than in the Yucatan (more than 10 times as high), and there is likely less confinement (57% of households in New Providence compared with 68% in Merida), both populations had a broadly similar percentage of females breeding (37.5% in Merida and 40.6% in New Providence). In the Yucatan, the annual growth rates were between 15.3% and 19.3% for urban and rural areas (Ortega-Pacheco et al., 2005). This compares with our estimate of 27% for New Providence (which ignores migration in and out of the population). These observations support the hypothesis that unless 70% (Mackie, 2003) to 90% of the animals reported (Manning & Rowan, 1996) are prevented from breeding, the population will produce excess animals, many of whom would be expected to become part of the roaming population. These observations contrast with those in North America, where many dogs are neutered and only 4.4% of dog-owning households reported one or more litters yet multiple litters per household occurred (New et al., 2004).

It appears that the environment (both natural and human)—not how dogs are kept—is at present the most salient factor controlling the dog population. The humid subtropical environment, combined with lack of health care and diseases such as heartworm, venereal tumors, ticks, and canine distemper, probably all combine to reduce the life expectancy, limit the breeding frequency of dogs, and produce high infant morality in New Providence. Despite an ongoing spay/neuter program that has neutered more than 1,500 animals in 12 months (P. Bizzell, personal communication, June 22, 2005), little change in the neutering rate can be found since 1998, and the dog population continues to produce too many puppies. It would ap-

pear that neutering programs and animal welfare, group-based education has not yet caused carers to change the way they keep dogs so as to put a brake on the breeding of owned dogs.

Excess Dogs

Given the current reproduction rates, it is clear that the supply of dogs exceeds demand. The most popular method of disposing of unwanted dogs was to give them away. However, this finding is questionable; if all the unwanted dogs were given away, the owned-dog population would expand greatly, which is difficult to accept. Even allowing for a mortality rate of 35%, a 20% surplus of the owned-dog population is unwanted and left to be disposed of through animal welfare groups and giving away. In newspapers, dogs frequently are advertised for sale; it is possible that more pure-bred dogs are sold than respondents indicated. Overall, it appears that more people kill dogs than was admitted, other sources of losses are present (roadkill and poisoning), or abandonment is higher than reported. Abandonment is chosen when relinquishers wish to give the animal "a chance." A case of a Labrador owner who abandoned his dog on a beach so that "someone would claim it" is likely atypical only as far as the abandoned dog was not a potcake. Elsewhere, such as in Taiwan (Hsu, Severinghaus, & Serpell, 2003), it has been shown that dog-keeping practices contribute to the roaming dog population, and the linkage is most likely to be prevalent in The Bahamas.

CONCLUSIONS

This study provides important data on an owned-dog population, showing the extent to which the population produces excess puppies. This study points to the need for further research on disposal and loss of dogs as well as on how dogs are acquired, so that migration into and out of the population can be observed more directly. Comparisons with the dog populations in Merida and St. Maarten, environments similar to New Providence, indicate that current neutering efforts may prove ineffectual unless they can be sustained and expanded. If the neutering capacity of animal welfare groups cannot achieve the required neutering levels, these groups may need to refocus their efforts on other ways of reducing the owned-dog population and—by association—the roaming dog population. The data also indicate that only a holistic approach to respectful pet care will be successful in eliminating unwanted dogs.

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