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# Trends in Sheltering and Welfare at the Hawaiian Humane Society, Oahu, Hawaii

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One of the major goals of an animal welfare organization is to reduce the number of homeless, nonhuman animals in a community. In Hawaii, the Hawaiian Humane Society has provided numerous animal welfare services to work toward this goal, such as offering sterilizations and microchipping at reduced rates and facilitating animal adoptions and education. In addition, the Leash Law and the Cat Identification Program have increased animal welfare through increasing the responsibilities of companion animal caregivers (owners). The goal of this research was to assess if temporal changes in animal sheltering have occurred in Hawaii. The study assessed this by analyzing historical data on dogs (*Canis familiaris*) and cats (*Felis catus*) admitted, returned to owner, sterilized, euthanized, and adopted from the Humane Societies of Oahu, Hawaii, from 1993 to 2008. The study also analyzed dog and cat admittance and Honolulu population growth from 1975 to 2008. Sterilizations and pets returned to owners have increased significantly, whereas admittance and euthanasia rates have decreased significantly. Thus, although these data cannot conclusively state that there are fewer homeless animals in Hawaii, the results provide positive indicators of reducing homeless pets, especially when coupled with an increase in both the human population of Honolulu County and dog ownership.

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The millions of homeless cats and dogs in the United States have long been a concern (Arkow, 1991; Lord et al., 2006; Rowan, 1992; Zasloff & Hart, 1998). An estimated 110 million dogs and cats are predicted to reside within the United States (Rowan, 1992), although the number of households available to accommodate all these nonhuman animals is inadequate (Clancy & Rowan, 2003). Approximately 3,500 to 5,000 animal welfare shelters across the United States have been grappling with this homeless issue for decades (Humane Society of the United States [HSUS], 2009; Rowan, 1992).

An estimated 6 to 8 million companion animals are relinquished to shelters each year in the United States (HSUS, 2009). In a Regional Shelter Study conducted by the National Council on Pet Population Study and Policy (NCPSP, 2008), the most frequently cited reason for dog relinquishment—and second most cited reason for cat relinquishment—by caregivers (owners) was aggression; soiling the house was the most frequently cited reason for cat relinquishment (Salman, Hutchison, & Ruch-Gallie, 2000). On the other hand, other studies have found that moving was the primary reason for relinquishment (Adkins, 2008; Arkow & Dow, 1984; Irvine, 2003; NCPSP, 2008). Other reasons noted for relinquishment include the number of pets in the household, the number of pets added to the household, the neuter/spay status of the animal, training level, pet age, length of ownership, acquisition from a shelter, the state in which the pet was relinquished, pet-owner income, landlord issues, personal problems, and allergies (Arkow & Dow, 1984; NCPSP, 2008; Salman et al., 2000).

During the 1970s, between 13.5 and 18.6 million dogs and cats were euthanized annually at U.S. animal shelters (Lord, Wittum, & Scarlett, 2007; Rowan, 1992). Subsequently, efforts such as public education, microchipping, and low-cost sterilization programs were implemented to reduce the number of animals euthanized at animal shelters (Arkow, 1991; Clancy & Rowan, 2003; Frank & Carlisle-Frank, 2007). Today, the number of animals euthanized has declined to between 3 and 4 million (HSUS, 2009; Lord et al., 2007; Rowan, 1992), indicating that efforts in reducing homeless or unwanted pets have been effective. This reduction is even more dramatic when one notes that, in the United States, the human population has grown by more than 35% and the dog and cat population by roughly 116% (American Veterinary Medical Association, 2007) over the last 30 years.

Although anecdotal information about admittance, adoption, euthanasia, and other vital rates are broadly estimated, there have been relatively few investigations, which are critically needed, published in the peer-reviewed literature on such rates at the shelter or at the local level (Clancy & Rowan, 2003; Djerassi, Israel, & Jochle, 1973; Rowan, 1992). Hawaii is one particularly important location for assessing temporal trends in animal welfare because of its unique geography, tropical climate, lack of predators in the wild, growing and transient human population, increasing pet ownership, and detrimental role that feral/stray

animals have on native species. In addition, the Hawaiian Islands are one of the most isolated inhabited landmasses in the world.

The Hawaiian Humane Society (HHS) provides animal welfare services to the entire island of Oahu, Hawaii (Honolulu County), the most densely populated of all the Hawaiian Islands. The HHS is not a chapter of the HSUS and does not receive funding from any other mainland organization or any other island humane society. The HHS maintains an open-door policy and never turns people away. The HHS offers advice and counseling to prospective pet owners; each animal kennel has information on the personality of the animals. Adoption fees for dogs and cats are \$65 and include the animal's sterilization, temperament screening, health examination, distemper and parvo (dogs only) vaccinations, heartworm test (dogs only), deworming, microchipping, flea treatment, and postadoption health care for 2 weeks. The HHS also offers a free Animal Behavior helpline to answer animal behavioral questions.

Although the population size of stray and feral cats and dogs on Oahu is unknown, it is estimated that 64% of Oahu households own pets (including birds, fish, and rabbits), with more than twice as many dog (73%) owners than cat (30%) owners (Ward Research, 2008). Moreover, dog ownership has shown a marked increase of 19% on Oahu since 1993 (Ward Research, 2008). Of Oahu's pet-owning households, 81% owned cats and 65% owned dogs who were sterilized (Ward Research, 2008). To put this in context, approximately 63% of households across the United States own companion animals; roughly 40% of these households own dogs, and 35% own cats (American Pet Products Association, 2009). Of these U.S. pet owners, 87% owned cats and 75% owned dogs who were sterilized.

There have been notable changes in animal welfare laws and programs designed to decrease the number of homeless animals on Oahu. For instance, in 1963, the City and County (C&C) of Honolulu's Leash Law was established. This law required owners to maintain control of their dogs in public places; the law further required impounding any dogs found roaming loose (Revised Ordinance of Honolulu: Section 7; Article 4; 2002). Although codified in the 1960s, the Leash Law was not fully enforced until the late 1970s (P. Burns, personal communication). More recently, the Cat Identification Program, enacted in 1995 by the C&C, requires that all outdoor cats be sterilized and have visible identification or a microchip. This Cat Identification Program also extended the minimal holding period to 9 days for all collared, microchipped, or tagged cats admitted to the HHS (Revised Ordinance of Honolulu: Section 7; Article 6; C&C, 2002). A cat who does not have identification must be held for a minimum of 2 days, unless the cat is in suffering that cannot be relieved (Revised Ordinance of Honolulu: Section 7; Article 6; City and County of Honolulu, 2010).

In addition to the Leash Law and the Cat Identification Program, several sterilization programs have gone into effect on Oahu during the past several

decades. Since 1986, the HHS has administered the Neuter Now Program, an educational and reduced-cost sterilization program funded by the C&C and participating veterinarians. Similarly, the Feral Cat Sterilization Program was established in 1991 to reduce the feral cat population through provision of free sterilization, ear notching, and low-cost microchipping (provided since 1996) to homeless, free-roaming cats (HHS, 2004). This program is only offered to cat caretakers who are caring for a colony or stray feral cats. All participants must complete and sign the Feral Cat Sterilization Program Agreement, which then registers the cat under the caretaker's name (HHS, 2010), easily identifiable to the HHS by ear notching. With ownership assumed, a feral cat is more likely to be returned if an individual brings the cat into a clinic, and the animal is kept for a longer holding period due to the extended minimum holding period for animals with identification (P. Burns, personal communication).

In order to assess whether animal welfare and sheltering organizations are achieving their goal of reducing the number of homeless animals, it is critical to evaluate sheltering vital statistics over time. Moreover, it is critical to evaluate sheltering statistics in locations such as Hawaii, which has unique cultural, climatic, and geographic conditions. Additionally, animal population trends at the HHS are a proxy of what is happening to the animal population on Oahu in general. This is important in assessing the amount of free-roaming animals who are affecting Oahu's fragile environment and endangered species populations. Based on these considerations, the objective of this research was to investigate if the HHS vital rates on the island of Oahu have changed over time and, if so, whether they were related to changes in any animal welfare laws or programs.

## METHOD

To determine if vital statistics at the HHS (Table 1) have changed over time, analyses were conducted on all historical records pertaining to cats and dogs from 1975 to 2008. These records were obtained from the Multiple Options Shelter Management Systems software maintained by the HHS. Specifically, when an individual or HHS employee brings in an animal to the HHS for admittance, a basic set of data are immediately collected. The admitters are given a form based on whether they are surrendering their personal animal (referred to as "owner surrendered" from here on) or admitting a stray animal, who may be a cat or dog who has wandered from home or one who is feral (partly or wholly wild). The individual admitting the animal signs off all paperwork copies or an HHS staff member fills out the paperwork and the admitter signs off. Admittance data are subsequently entered into the Multiple Options Shelter Management Systems software and tabulated on a fiscal year (FY) basis. The FY begins July 1 and ends on June 30 of the following year. The Multiple

TABLE 1  
 Regressions Run on Vital Statistics for the Corresponding Dates

<i>Variable</i>	<i>Dates</i>
Human population of Honolulu County	1970, 1980, 1993, 2008
Animal admittance	1975–2008
Animal admittance: surrendered and stray	1993–2008
Returned to owner	1993–2008
Returned to owner through microchip	1996–2008
Adopted	1993–2008
Euthanized	1993–2008
Reasons for dog euthanasia	2001–2006
Sterilizations	1975–2008
Neuter Now and Feral Cat Sterilization programs	1993–2008
Promotional program	1996–2008

*Note.* Each variable included both cats and dogs unless otherwise indicated.

Options Shelter Management Systems software was implemented in 2001 and has remained in use since that time. All records prior to 2001 were entered into the software when purchased and double-checked to ensure no data entry errors occurred. No methodological changes were made in data collection following the implementation of the Multiple Options Shelter Management Systems software.

Cat and dog vital statistics assessed in this study include admittance, stray and surrendered intake, returns to owner, adoptions, animals euthanized, reasons for dog euthanasia, sterilizations, and sterilizations through the Neuter Now, promotional, and Feral Cat Sterilization programs. In addition to the animal vital statistics, the human population data for Honolulu County for 1970, 1980, 1993, and 2008 (State of Hawaii, 2006, 2010) were included. These population data include military and college students who resided in the county for a majority of the year (U.S. Census, 2009). The Honolulu County human population was estimated for 1975 by averaging the 630,528 citizens in 1970 and the 696,547 citizens in 1980 (State of Hawaii, 2006). Census data collected by the State of Hawaii were ultimately from the U.S. Census; however, they were modified by the Hawaii Department of Business, Economic Development & Tourism (State of Hawaii, 2006).

The number of animals admitted includes all cats and dogs impounded at the shelter, both stray and surrendered. The number of adoptions, returns to owner, and animals euthanized is equal to the number of animals admitted each FY. Animals recorded specifically for sterilization through the Neuter Now, promotional, or Feral Cat Sterilization program were not included in this number as they were not impounded.

Prior to analyses, Pearson correlations were run on each vital statistic (sterilizations were not included because they were not considered at intake) to

determine collinearity between variables from 1993 to 2008. Correlations with an  $r$  value of  $\geq 0.5$  were considered significant. All vital statistics, whether or not found to be collinear, were divided into the intake (each FY, the vital statistic was divided by that year's intake) to determine a proportion, thereby removing collinearity if it occurred—at the same time allowing for comparison of proportional rates over time. The proportional vital statistic was then analyzed within the same regression framework as the other vital statistics (see below).

Regressions were performed to determine if vital statistics have changed over time. Notably, because annual vital statistics are independent events, autoregressive models were not used (Sokal & Rohlf, 1995). Because the goal of the research was to investigate if vital statistics had changed, we initially used a linear regression approach. In cases where the plots of raw data suggested distinctly nonlinear (parabolic) relationships, we ran quadratic and cubic models in addition to the linear models. In cases where multiple models were run for a specific vital statistic, we used adjusted- $R^2$  (adj. $R^2$ ), Akaike information criterion, and partial  $p$  values to determine which model was the “best fit” (Lepczyk et al., 2008). There were no a priori tests performed because there were no known changes or laws for those cases. Results of the models were considered significant for any relationship that had a  $p$  value of  $\leq .05$  and an adj. $R^2 \geq 0.10$  (Lepczyk et al., 2008).

Each vital statistic was analyzed separately over the time it was recorded (Table 1) for cats, dogs, and cats + dogs. Due to how data were recorded, the HHS sterilizations included guinea pigs and rabbits (although these numbers are likely to be minimal) in addition to cats and dogs. In the cases of “reasons for dog euthanasia” following relinquishment and “feral cat sterilizations,” data were analyzed only for these species individually. Analyses were not run on the reasons for cat euthanasia following relinquishment because these data have yet to be collated by HHS.

To investigate whether vital rates changed following the Cat Identification Program enacted in 1995, a general linear model (GLM) was used to compare animal admittance before and after codification. In addition, because the HHS changed its hours of animal admittance from 8:00 a.m. to 3:00 p.m., Monday through Friday, to being open 24 hr a day, 7 days a week, in 1992, a before-and-after comparison was also made using a GLM.

For contextual purposes only, vital statistics in 1993 versus 2008 are compared by determining the percentage of each vital statistic total with the total admittance of that time. The percentage increase/decrease in vital statistics of both cats and dogs was calculated by subtracting the number in 1993 from the total in 2008 for each category. This number was then divided by the category's 1st year and multiplied by 100 to denote percentage change. All statistical analyses were conducted using SYSTAT 10 (SPSS Inc., 2002).

## RESULTS

## Animal Admittance

From 1975 to 2008, a total of 982,973 companion animals (567,531 cats and 415,442 dogs) were admitted to HHS. Yearly intake has ranged from a peak of 42,182 cats and dogs in 1978 to a low of 21,730 in 1987. During these 33 years, animal admittance decreased significantly (Figure 1;  $F_{1,32} = 25.75$ ,  $\text{adj.}R^2 = 0.43$ ,  $p < .0005$ ). Dog admittance decreased significantly, exhibiting a quadratic model ( $F_{2,31} = 62.46$ ,  $\text{adj.}R^2 = 0.79$ ,  $p < .0005$ ), whereas cat admittance did not change during these 33 years (Figure 1;  $F_{1,32} = 1.39$ ,  $\text{adj.}R^2 = 0.01$ ,  $p = .247$ ). However, when cat admittance rates were analyzed after the establishment of the Cat Identification Program in 1995, there was a marginal decrease in cats ( $R^2 = 0.158$ ; Cat Admittance:  $F_{1,30} = 3.94$ ,  $p = .06$ ; Time effects:  $F_{1,30} = 1.05$ ,  $p = .31$ ; Cat Admittance  $\times$  Time:  $F_{1,30} = 1.05$ ,  $p = .06$ ). Compared with intake in 1995, cat admittance had decreased by 22% in 2008.

Following the increase in the HHS hours of operation in 1991, there was a significant change in animal admittance ( $R^2 = 0.84$ ; Cat Admittance:  $F_{1,30} = 61.35$ ,  $p < .0005$ ; Time effects:  $F_{1,30} = 71.73$ ,  $p < .0005$ ; Cat Admittance  $\times$  Time:  $F_{1,30} = 61.59$ ,  $p < .0005$ ). Immediately following the extension of hours in 1991, a spike of approximately 5,000 animals admitted occurred the following

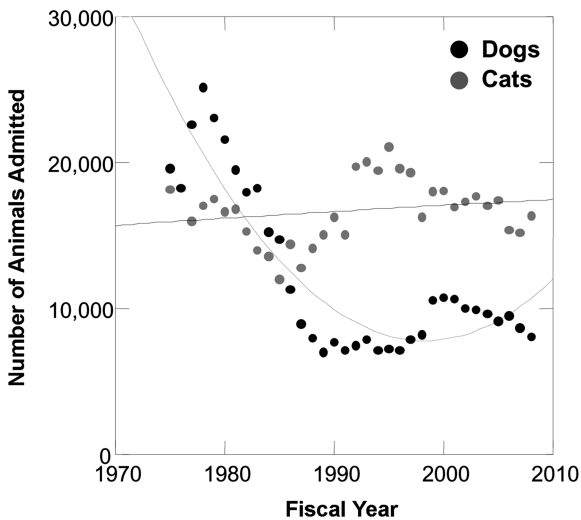


FIGURE 1 Annual admittance rates of cats and dogs at the Hawaiian Humane Society from 1975 to 2007. Lines represent linear or quadratic regression model fits, which were not significant for cats but are significant for dogs.



year (Figure 1). Cat and dog admittance decreased following this initial increase. However, the decrease in admittance was lower following the increase in hours of operation.

Since 1975, the human population in Honolulu County has significantly increased ( $F_{1,11} = 164.73$ ,  $\text{adj.R}^2 = 0.93$ ,  $p < .0005$ ) from 663,537 to 902,745 people. Although the human population of Oahu grew by approximately 18%, the total number of dogs admitted to HHS during the same time decreased by approximately 35%. Because the cat population did not change significantly during this time frame, it was not included in the comparison to the human population.

### Stray and Surrendered by Owner

From 1993 to 2008, a total of 286,424 cats were admitted to HHS, of whom 222,374 (78%) were strays and 64,050 (22%) were surrendered by their owners (Table 2). Of the owner surrenders, 3,842 were owner requests for euthanasia. The total number of cats admitted to the HHS decreased significantly during this time ( $F_{1,14} = 31.00$ ,  $\text{adj.R}^2 = 0.67$ ,  $p < .0005$ ). Likewise, both the number of stray cats (Figure 2;  $F_{1,14} = 5.70$ ,  $\text{adj.R}^2 = 0.24$ ,  $p = .032$ ) and owner-surrendered cats ( $F_{1,14} = 178.97$ ,  $\text{adj.R}^2 = 0.92$ ,  $p < .0005$ ) decreased significantly between 1993 and 2008. Although both stray and surrendered cats decreased over time, there was a notable change in their respective proportions. Specifically, the proportion of cats who were surrendered decreased ( $F_{1,14} = 26.51$ ,  $\text{adj.R}^2 = 0.63$ ,  $p < .0005$ ) relative to the proportion of stray cats admitted,

TABLE 2  
Cat and Dog Intake and Vital Statistics at the Hawaiian Humane Society from 1993 to 2008

Fiscal Year	Species	Total Intake	Stray	Surrendered	Returned to Owner	Euthanized	Adopted
1993	Cat	20,029	14,325 (71.5%)	5,704 (28.5%)	175 (0.9%)	16,843 (84.1%)	2,772 (13.8%)
2008	Cat	16,361	13,682 (83.6%)	2,679 (16.4%)	686 (4.2%)	12,080 (77.6%)	2,539 (15.5%)
% Change 1993 to 2008	Cat	-18.3	-4.5 <sup>a</sup>	-53.0 <sup>a</sup>	+292 <sup>a</sup>	-28.3 <sup>a</sup>	-8.4
1993	Dog	7,859	3,110 (39.6%)	4,749 (60.4%)	837 (10.7%)	3,351 (42.6%)	2,764 (35.2%)
2008	Dog	8,046	4,641 (57.7%)	3,405 (42.3%)	1,801 (22.4%)	2,976 (35.1%)	2,839 (35.3%)
% Change 1993 to 2008	Dog	+2.4 <sup>b</sup>	+49.2 <sup>b</sup>	-28.3	+115.2 <sup>a</sup>	-11.2 <sup>b</sup>	+2.7

Note. Parenthetical % indicate the % of total cat/dog admittance during that fiscal year due to type of admittance (stray or surrendered, which sums to 100%) and the outcome (return to owner, euthanized, or adopted, which sums to 100%).

<sup>a</sup>Indicates a significant linear change from 1993 to 2008. <sup>b</sup>Indicates a significant quadratic relationship during this time.

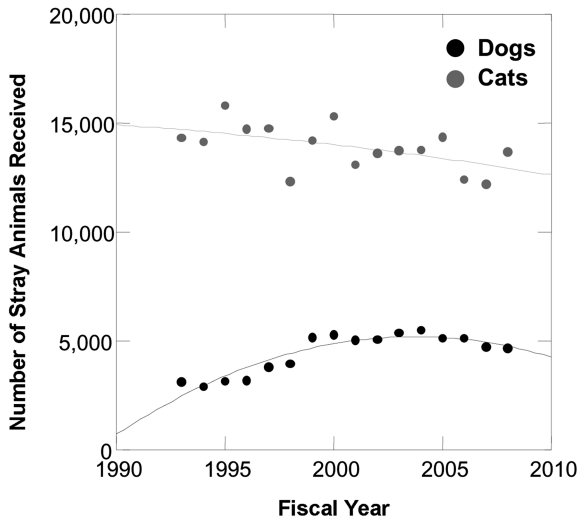


FIGURE 2 Number of stray cats and dogs received from 1993 to 2008.

which increased ( $F_{1,14} = 95.46$ ,  $\text{adj.R}^2 = 0.86$ ,  $p < .0005$ ). Thus, in 1993, about 28% of cats were surrendered, and hence 72% were strays, compared with 2008, when approximately 16% of cats admitted were surrendered and 84% were strays.

In the case of dogs, 142,243 were admitted to HHS between 1993 and 2008, divided almost equally between strays (71,078; 50%) and owner surrenders (71,165; 50%; Table 2). Of the owner surrenders, 14,208 were requests for euthanasia. Over this 15-year period, there was no change in the total number of dogs admitted to the HHS ( $F_{1,14} = 3.62$ ,  $\text{adj.R}^2 = 0.15$ ,  $p = .078$ ). Although the number of surrendered dogs did not change over this period ( $F_{1,14} = 0.78$ ,  $\text{adj.R}^2 = 0.00$ ,  $p = .39$ ), stray dog admittance did change. Specifically, stray dog admittance was best fit with a quadratic model, showing a significant increase, followed by a slight decrease in more recent years (Figure 2;  $F_{2,13} = 41.77$ ,  $\text{adj.R}^2 = 0.85$ ,  $p < .0005$ ). Proportionately, the admittance of dogs via surrenders decreased from about 60% in 1993 to 42% in 2008 ( $F_{1,14} = 136.45$ ,  $\text{adj.R}^2 = 0.90$ ,  $p < .0005$ ), with the reciprocal increase occurring via strays ( $F_{1,14} = 136.45$ ,  $\text{adj.R}^2 = 0.90$ ,  $p < .0005$ ).

### Returned to Owner

Approximately 2.7% (7,479) of the cats admitted and 17% (24,881) of the dogs admitted to HHS between 1993 and 2008 were returned to their owners

(Table 2). The number of owner returns has increased significantly for both cats ( $F_{1,14} = 36.18$ ,  $\text{adj.R}^2 = 0.70$ ,  $p < .0005$ ) and dogs (Figure 3;  $F_{1,14} = 27.15$ ,  $\text{adj.R}^2 = 0.64$ ,  $p < .0005$ ). These increases are correlated to the number of cats and dogs admitted to the HHS. As dog admittance increased, so did the amount of dogs returned to owner ( $r = 0.80$ ). To eliminate collinearity, we then analyzed the proportion of dogs returned to owner and found that there was still a significant increase in returns ( $F_{1,14} = 40.30$ ,  $\text{adj.R}^2 = 0.72$ ,  $p < .0005$ ).

Although cat admittance has decreased, the number returned to owners has increased ( $r = -0.81$ ). When the proportional rate of return was analyzed, there was still a significant increase in return to owner ( $F_{1,14} = 62.47$ ,  $\text{adj.R}^2 = 0.80$ ,  $p < .0005$ ). The cat return-to-owner rate increased from 0.9% (138 cats) of the stray cats admitted (138 cats) in 1995 to 3.2% (472 cats) in the year following the 1995 Cat Identification Program.

Since 1996, nearly 13,000 animals (5,221 cats and 7,709 dogs), or 4.4% of the total cats and dogs admitted, were returned to their owners due to the use of microchips (Figure 3). In the first year of returns (1996), only about 5% of dogs and 13% of cats returned to their owners were microchipped, compared with 2008, when about 42% of dogs and 81% of cats returned were microchipped. Hence, both the proportion of dogs ( $F_{1,11} = 11.62$ ,  $\text{adj.R}^2 = 0.47$ ,  $p < .006$ ) and cats ( $F_{1,14} = 12.25$ ,  $\text{adj.R}^2 = 0.48$ ,  $p < .005$ ) who were returned to their owners through the use of microchips increased over time.

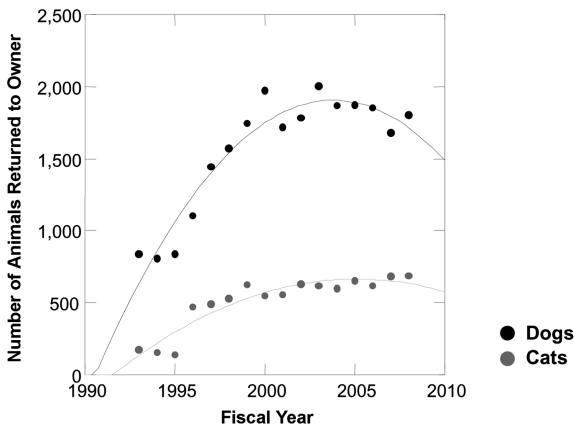


FIGURE 3 Cats and dogs returned to their owners from 1993 to 2008. There is a marked spike in both cats and dogs returned to owner following the use of microchipping that began in 1996.

## Euthanasia

Of the total cats received between 1993 and 2008, roughly 82% (235,114 cats) were euthanized. During this 15-year period the number of cats euthanized decreased significantly (Figure 4;  $F_{1,14} = 79.99$ ,  $\text{Adj.R}^2 = 0.84$ ,  $p < .0005$ ), representing a decrease of 28.3% from the 16,843 cats per year in 1993 to the 12,080 cats per year in 2008 (Table 2). Because cat euthanasia and cat admittance numbers were correlated ( $r = 0.94$ ), the proportional rate was also analyzed. Specifically, the proportion of cats euthanized still showed a significant decline over time ( $F_{1,14} = 31.90$ ,  $\text{adj.R}^2 = 0.67$ ,  $p < .0005$ ).

With regard to dogs, approximately 51% (72,430 dogs) of the total dogs admitted to HHS were euthanized between 1993 and 2008. The number of dogs euthanized changed significantly over this period, with rates exhibiting a quadratic relationship where they increased until about 2000 followed by a decrease (Figure 5;  $F_{2,13} = 13.06$ ,  $\text{Adj.R}^2 = 0.62$ ,  $p < .0005$ ). As with cat euthanasia rates, dog euthanasia numbers were correlated to dog admittance numbers ( $r = 0.90$ ). When looking only at the proportion of dogs euthanized, there was no longer a significant decrease over time ( $F_{1,14} = 0.74$ ,  $\text{adj.R}^2 = -0.02$ ,  $p = .36$ ). Overall, the proportion of cats + dogs euthanized has shown a significant decrease over time ( $F_{1,14} = 33.81$ ,  $\text{adj.R}^2 = 0.67$ ,  $p < .0005$ ).

From 2001 to 2006, data were collected on the reasons for euthanasia of dogs admitted to the HHS. A total of 30,261 dogs were euthanized during this 6-year period. The seven reasons, from most to least common, were as

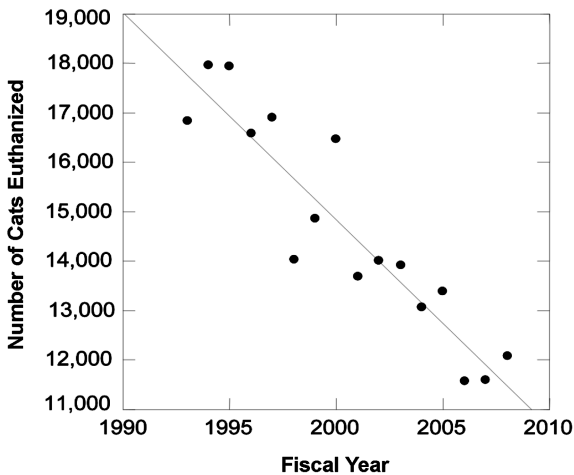


FIGURE 4 Number of cats euthanized per year from 1993 to 2008.

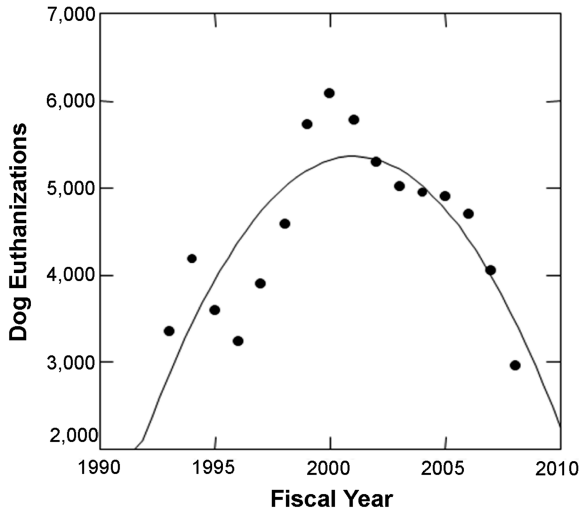


FIGURE 5 Number of dogs euthanized per year from 1993 to 2008.

follows: First, 11,964 dogs (39.5%) were euthanized due to behavioral issues, which did not change over time ( $F_{1,4} = 2.15$ ,  $\text{adj.R}^2 = 0.19$ ,  $p = .216$ ). Second, 10,285 (34.0%) dogs were euthanized due to the animal's being injured or sick, which declined significantly from 2001 to 2006 ( $F_{1,4} = 21.98$ ,  $\text{adj.R}^2 = 0.81$ ,  $p < .05$ ). Third, there were 4,787 (15.8%) dogs euthanized due to owner requests, which has increased significantly over time ( $F_{1,4} = 11.80$ ,  $\text{adj.R}^2 = 0.68$ ,  $p < .05$ ). Fourth, there were 1,333 (4.4%) dogs euthanized due to the animal's being geriatric, which remained constant over time ( $F_{1,4} = 0.75$ ,  $\text{adj.R}^2 = 0.00$ ,  $p = .436$ ). Fifth, there were 1,151 (3.8%) dogs euthanized due to the animal's being a newborn, which remained constant over time ( $F_{1,4} = 4.36$ ,  $\text{Adj.R}^2 = 0.40$ ,  $p = .105$ ). Sixth, there were 439 (1.5%) adoptable dogs euthanized, which declined significantly from 2001 to 2006 ( $F_{1,4} = 14.15$ ,  $\text{adj.R}^2 = 0.72$ ,  $p < .05$ ). Finally, there were 302 (0.9%) dogs euthanized due to the animal's being heartworm positive, which remained constant over time ( $F_{1,4} = 3.04$ ,  $\text{adj.R}^2 = 0.29$ ,  $p = .156$ ). Behavioral ( $r = 0.52$ ), injured or sick ( $r = 0.80$ ), newborn ( $r = 0.69$ ), adoptable ( $r = 0.77$ ), and heartworm positive conditions were positively correlated to the decrease in dog admittance. However, owner requested ( $r = -0.75$ ) and geriatric ( $r = -0.59$ ) conditions were negatively correlated to dog admittance. When the proportional rate of each reason was investigated in relation to dog admittance, only owner requests for euthanasia changed over time ( $F_{1,4} = 5.25$ ,  $\text{adj.R}^2 = 0.75$ ,  $p < .05$ ).

TABLE 3  
Comparison of Sterilizations Performed by HHS, C&C, and  
Three Reduced-Rate Sterilization Programs Between 1975 and 2008

	<i>HHS</i>	<i>C&amp;C</i>	<i>Neuter Now</i>	<i>Feral Cat</i>	<i>Promotional</i>
Time frame	1975–2008	1986–2008	1993–2008	1993–2008	1997–2008
Number sterilized	140,820	192,669	65,583	36,722	7,100

*Note.* HHS sterilizations include guinea pigs and rabbits, whereas feral cat sterilizations include cats only. All other sterilizations pertain to cats and dogs.

### Sterilizations

Since 1975, more than 140,000 sterilizations (including rabbits and guinea pigs) have been performed at the HHS (Table 3). By 2008, the number of sterilizations performed had grown by 529% ( $F_{1,32} = 95.10$ ,  $\text{adj.R}^2 = 0.74$ ,  $p < .0005$ ). Since 1993, there has been an 84% increase in sterilizations performed by the HHS ( $F_{1,14} = 7.65$ ,  $\text{adj.R}^2 = 0.31$ ,  $p < .05$ ). However, the Neuter Now sterilization program has had a 27% decrease ( $F_{1,14} = 39.58$ ,  $\text{adj.R}^2 = 0.72$ ,  $p < .0005$ ) in sterilizations during the same time. Between 1993 and 2008, the Neuter Now Program provided sterilizations to more than 65,000 cats and 71,000 dogs. In addition, 7,100 cats have been sterilized from a promotional discount program that has been running since 1997. There has not been a significant change in sterilizations during the time over which the promotional program has been in operation ( $F_{1,10} = 0.31$ ,  $\text{adj.R}^2 = 0.00$ ,  $p = .59$ ). At the same time, the number of sterilizations by the Feral Cat Sterilization Program has significantly increased ( $F_{1,14} = 26.54$ ,  $\text{adj.R}^2 = 0.63$ ,  $p < .0005$ ). Since 1993, nearly 37,000 feral cats have been sterilized through this program. The overall number of sterilizations provided by HHS, C&C, and all HHS-sponsored programs have significantly decreased since 1993 ( $F_{1,14} = 7.38$ ,  $\text{adj.R}^2 = 0.30$ ,  $p < .05$ ).

### Adopted

Between 1993 and 2008, a total of 42,378 cats were adopted, accounting for 15% of the cats received at HHS since 1993. Similarly, 44,624 dogs have been adopted from HHS since 1993, accounting for 31% of the dogs who have entered the HHS (Table 2). The number of both cats ( $F_{1,14} = 1.77$ ,  $\text{adj.R}^2 = 0.05$ ,  $p = .204$ ) and dogs ( $F_{1,14} = 0.12$ ,  $\text{adj.R}^2 = 0.00$ ,  $p = .732$ ) adopted each year has stayed the same over time. Although the number of animals adopted remained constant, the annual adoption rate (# adopted/# admitted) of cats showed a slight increase over time ( $F_{1,14} = 1.77$ ,  $\text{adj.R}^2 = 0.24$ ,  $p = .031$ ), from about 14% to 16%; for dogs, it exhibited a negative quadratic relationship ( $F_{1,14} = 1.77$ ,  $\text{adj.R}^2 = 0.24$ ,  $p = .031$ ); it declined from about 44% in 1995 to 26% around

the turn of the century and has since increased to about 35%. Adoptions were not correlated to cat ( $r = 0.45$ ) or dog admittance ( $r = -0.25$ ) numbers.

## DISCUSSION

Although the human population and pet ownership on Oahu have increased, the number of cats and dogs admitted to the HHS has decreased over the past 33 years (Figure 1). Cat admittance did not decline significantly until the enactment of the Cat Identification Program in 1995, demonstrating the program's effectiveness at decreasing strays. Spikes in admittance throughout the analyzed period (Figure 1) can be attributed to several factors. Specifically, in 1978, enforcement of the Leash Law, in which loose dogs were actively retrieved, likely resulted in the subsequent increase of 2,550 dogs. Likewise, the 26% (5,722 animals) spike in cat and dog admittance from 1991 to 1993 closely corresponds to when the HHS increased animal receiving hours from 8 hr per day to 24 hr per day, 7 days a week.

A decrease in cat and dog admissions has been found in other areas of the United States as well. For instance, trends for animal care and control agencies in Ohio from 1996 to 2004 found a decrease of 7% of the animals handled (Lord et al., 2006). Similarly, animal intake at shelters in New Jersey decreased by 29% between 1984 and 1999, whereas the state's population increased by 8% (Handy, 2001). The admission of more cats than dogs to the HHS is also similar, relative to other studies. Luke (1996) stated that more often than not, cats "find their people" instead of people deliberately choosing to own a cat. This unintentional ownership has been linked to cats receiving a lower level of care than dogs (Luke, 1996). Specifically, the consequences of cats receiving less care, such as veterinary assistance, affects animal shelters (often called on to respond when lack of medical care causes suffering in cats), leads to unwanted kittens, or raises concerns in the neighborhood. Hence, this lower level of care might partially explain underlying reasons why cat admittance rates are nearly twice that of dog admittance rates.

Even with the rising popularity in microchipping and the requirements imposed by the Cat Identification Program, lost cats still remain a serious welfare problem in Hawaii and across the United States. On average, the HHS returned over three times as many dogs as cats to their owners. This rate of return is especially concerning since there have been over 144,000 more cats than dogs received at the HHS since 1993. The promotion of microchipping animals other than those admitted to the HHS would likely be beneficial to the welfare of both cats and dogs.

The stray cat population shows a general decreasing trend; however, a cyclical pattern appears, perhaps due to natural variation in the environment that could

affect stray animal populations (G. Bruland, personal communication). Although the exact reasons for such a cyclical pattern are beyond the scope of this study, these numbers and trends are beneficial for helping natural resource managers understand what is occurring within local stray animal populations. This is important because removing stray animals plays a large role in helping Hawaii's native ecosystems.

Further studies are needed to determine why an increase in stray dogs is occurring. Factors that may have caused this increase include a higher occurrence of people choosing to pick up stray dogs when they see them or a greater number of people abandoning their animals before they move. Additionally, lower admittance fees for stray animals and an owner's feelings of guilt or embarrassment may have led to this increase (P. Burns, personal communication).

The rich cultural and demographic diversity of Hawaii may be a factor in both stray and surrendered cat and dog admittance. Some cultures may not be as centered on indoor animals or may not be predisposed to bringing their animals in to a place such as the HHS. Additionally, year-round warm temperatures, an abundant rodent population, and numerous cat colony caretakers (Zasloff & Hart, 1998) may contribute to reasons strays are more abundant on Oahu than in the continental United States.

Dog euthanasia and admittance rates were correlated with one another and showed no change over time when euthanasia was analyzed as a proportion of admittance; this indicated that the decrease in dog euthanasia was at least partly due to the decrease in admittance (Table 2). However, the change in the number of cats euthanized was found to be independent of admittance. Adoption rates have remained constant and are thus assumed not to have contributed to the decrease in the number of cats euthanized. A greater return-to-owner rate from the increased usage of microchips, decreased inflow of stray cats, and the inception of the Cat Identification Program may have also contributed to the decreased euthanasia rates. The reason for a shift from an increase in dog euthanasia to a decrease following the FY 2000 is likely to have been caused by the increase, then decrease, in admittance during this time. Future research on these trends may prove beneficial, as the exact reasons leading to this interesting quadratic relationship are beyond the scope of this analysis.

In 1993, roughly 234 cats and dogs per 10,000 humans were euthanized in Honolulu County; this compares with 167 dogs and cats per 10,000 humans in 2008, representing a 29% decrease. The number of animals euthanized in 2008 at the HHS is greater than the average U.S. estimation of 138 per 10,000 individuals (Animal People, 2008). Similarly, the ratio of cat to dog euthanasia is 4:1 on Oahu, whereas the total U.S. estimation is close to 1:1 (Animal People, 2008).

Increases in sterilizations performed by the HHS and decreases in those supported by the C&C (Neuter Now) are likely due to changes in the amount of funding provided by C&C, which has decreased in recent years. Feral cat



sterilizations began to increase notably in the years following the elimination of procedural fees in 1992. Although a cause-and-effect relationship with increased sterilizations and decreased euthanasia was beyond the scope of this research, such a relationship may exist. One female dog who is not sterilized can give birth to 6 to 10 puppies twice a year (HHS, 2006). After 6 years, 1 female dog and her offspring can produce more than 60,000 dogs in a lifetime (HHS, 2006). Thus, although sterilizations may not be decreasing animal admittance and euthanasia, it is still a plausible tool for stabilizing the population. Lord et al. (2006) suggests that sterilizations also act to improve the public perceptions of animals available for adoption, contributing to a decrease in euthanasia.

Although Ward Research (2008) states that HHS is a “top-of-mind” source for where to get a pet (38%), our results indicate that the number of adoptions has not changed at HHS. Cat adoptions have averaged 2,648 cats per year, whereas dog adoptions were slightly greater at 2,789 adoptions per year. Of the cat and dog owners, only 14% reported getting their most recent pet from the HHS, whereas friends and family members (41%) were cited most frequently (Ward Research, 2008). Considering this lack of change in adoptions over time, more promotional materials are suggested to encourage adoptions from the HHS and other shelters. Such encouragement is particularly relevant given that owners who have adopted their pets from shelters are more attached to them than owners who have acquired pets from other sources (Zasloff, 1995).

Although beyond the scope of this study, several factors that characterize Hawaii may contribute to homeless animal trends. Pet owners face large costs for moving animals to the mainland or overseas. For instance, to travel to the mainland United States can cost anywhere from \$125 carry-on to more than \$1,100 (not including taxes or surcharges) for an extra-large dog (Hawaiian Airlines, 2010; United Air Lines, 2010). In addition, the year-round warm tropical weather conditions and lack of wild predators potentially allow for increased animal fecundity and survivorship. Another consideration is that 4% of the population (31,681) is military personnel (State of Hawaii, 2010), a community that typically transfers frequently, often on short notice (Chumley, Gorski, Saxton, Granger, & New, 1993). Companion animals often had to be left behind during these transfers (Anderson, 1985; Chumley et al., 1993). For instance, although a majority of military surveyed considered their companion animal to be part of their family, 30% of the individuals who had an animal prior to moving to Oahu left their previous animal(s) behind (Anderson, 1985). Monetary and housing assistance in moving pets at military transfer time would potentially decrease the number of animals relinquished by military personnel. Finally, Hawaii has quite a transient population in that turnover among all sectors of the population is relatively high.

Although there are several positive indications that the number of homeless pets are decreasing and animal welfare on Oahu is increasing, other reasons for

a decrease in admittance may include an increased use of foster care programs, rescue groups, a change in owner attitudes, and increasing knowledge of animal overpopulation. Although little data were available from other animal welfare facilities on Oahu, follow-up interviews with all known organizations that have operated during the period of this study were conducted in order to assess their roles in sheltering and adoptions. A total of four other animal shelters, all of which are limited-admission facilities, are known to exist on Oahu: Joey's Feline Friends, Hawaii Cat Foundation, Hawaii Dog Foundation, and Hawaii Kai Animal Sanctuary. As the names imply, Joey's Feline Friends, Hawaii Cat Foundation, and Hawaii Dog Foundation are species specific. Since its inception in 1997, Joey's Feline Friends has adopted out approximately 300 cats annually and can house approximately 300 cats (T. Villaroz, personal communication). The Hawaii Cat Foundation, formed in 1993, has the capacity to hold 100–150 cats (Hawaii Cat Foundation, <http://www.hicat.org/HCF/Home.html>), but adoption rates are unknown. The Hawaii Animal Sanctuary has provided shelter for many animals since its inception in 1994; however, as noted on the informational material, "the guests/residents at the Sanctuary . . . are usually with the Sanctuary for their lifetime . . . most . . . are not adopted" (Hawaii Animal Sanctuary, <http://hawaiianimalsanctuary.org/>). Finally, the Hawaii Dog Foundation uses a network of foster homes to take a limited number of dogs through the assistance of 120 members of their current foster community. Roughly 452 dogs have been adopted from the Hawaii Dog Foundation since 2004. Specifically, these shelters may have contributed to a reduction in pet admittance rates to the HHS on the order of 300–500 cats per year and 100 dogs per year, which would have created only a minimal change in the intake of cats and dogs at the HHS during that time. In other words, the other shelters have neither the capacity nor the adoption rates to cause the significant reduction in admittances seen at HHS.

Finally, although the potential for bias or error in data can occur, the numerous staff, including the current CEO and several managers in the animal care department, have been with the HHS for more than 20 years. This long-term history for several employees and the continued engagement of the CEO of the HHS during this research make it less likely that any major errors in data collection and interpretation have occurred. Similarly, the consistency in personnel has resulted in consistent management style. As a result, the data presented here represent a valid long-term record of animal welfare vital statistics.

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