

## Surveys of dog populations in Taiwan from 1999 to 2009

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### ABSTRACT

This study estimated the total number of household and stray dogs, and the turnover rate in shelters in Taiwan from 1999 to 2009. Since 1999, the number of household dogs was assessed every two years, and the number of stray dogs every 5 years. The turnover number of dogs in shelters was documented annually by the government. Household dog population survey was conducted by telephone interviews and for each survey, the valid sample size was greater than 9,600. In each survey of stray dogs, they were “captured and removed” using photographs in 56-74 areas, between the years of 1999 and 2009. The results indicated that the number of household dogs decreased significantly from 2,340,576 in 1999 to 1,565,156 in 2009. The number of stray dogs decreased from 613,959 in 1999 to 120,476 in 2004, and further decrease was minimal as only 86,244 were estimated in 2009. The number of dogs entering the shelters increased from 78,686 in 1999 to 127,023 in 2009. The number of dogs euthanatized increased from 70,231 in 1999 to 94,440 in 2009. Data of this study can serve as a reference to related studies on rabies control or dog population control.

(Key Words: Animal shelter, Dog population, Household dogs, Stray dogs, Taiwan)

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## INTRODUCTION

In recent decades, there is an increasing awareness of animal protection that promotes empathy towards animals and opposes animal abuse (CETS, 1992; Rollin, 1999; Aronson, 2010). In Taiwan, domestic and international animal protection groups have fought over the last 20 years to advocate animal protection and welfare. Because stray dogs are frequently seen, the main concern of animal protection in Taiwan is pet overpopulation. In 1980s and 1990s, stray dogs were handled by the Environmental Protection Administration (EPA), which did not employ its own veterinarians. Without the professional knowledge and management provided by veterinarians, many stray dogs suffered mistreatment. Later, international organizations as well as local associations, all made efforts to urge the Taiwanese government to implement policies on the proper treatment of stray dogs (Rhoades, 2002; Leney and Remfry, 2000; Humane Society International, 2004).

Under lobbying from animal protection groups and scholars, the Taiwanese law workers and government promulgated the Animal Protection Act on November 4, 1998. The government also progressively enacted the following eight working practices: (1) implemented the pet registration system in 1999; (2) began to conduct surveys on the numbers of household and stray dogs in 1999; (3) established 42 public animal shelters (new or renovated) in 1999; (4) implemented a standard operating procedure for stray dog capture and disposition in 2001; (5) established the animal adoption system in 2001; (6) prohibited the slaughtering of pets for any commercial use in 2001; (7) enforced the pet business license system in 2001; and (8) enhance international exchange and cooperation (Sheu, 2005). Animal abuse may still occur, although the incidence shall decline as those measures mentioned above became effective.

The stakeholders involved in the issue of animal protection are many, include scientific, ethical, economic, and social communities (World Organization for Animal Health, 2002); hence, it would be difficult to establish effective and objective policies without statistical data. The data can also be served as standards to evaluate the effectiveness of policy implementation (Nassar and Fluke, 1991; Zawistowski et al., 1998). Beginning in 1999, the Taiwanese government regularly conducted national surveys on the number of household dogs every two years and on the number estimation of stray dogs every five years. There are also available records on the number of dogs entering and exiting animal shelters can be collected.

This study sourced data from the surveys on household and stray dogs since 1999. All survey records were subjected to statistical analyses, from which hypotheses were derived to explain the reasons for changes in these numbers. This compilation of data shall provide future studies with rational reference.

## METHODS

### 1. Estimation of national household dog populations

In the years of 1999, 2001, 2003, 2005, 2007, and 2009, household dogs were surveyed by

random-digit dialing telephone survey using the method of Griffiths and Brenner (Griffiths and Brenner, 1977). Population-based data on pet ownership and household demographics were obtained through a structured questionnaire. The survey data are summarized in Table 1. Samples were selected randomly based on the official national household distribution census of that year. The margin of error for all surveys was  $\pm 3$  percentage points, with confidence level was 99% for all surveys. Results of the questionnaire were analyzed in a database using Visual FoxPro version 6.0. The dog populations were estimated using the descriptions provided in Table 1. The number of total household dogs was estimated based on the number of total households in Taiwan, dog ownership percentage, and the average number of dogs per dog-owning household. The number of household dogs per 100 people in Taiwan was estimated as  $(\text{Total household dogs}/\text{Total human population}) \times 100$ .

## 2. Estimation of stray dogs in Taiwan

This study used anthropological inquiries to estimate the number of stray dogs (WHO/WSPA, 1990). Based on this principle, this study selected representative observation sites of stray dogs based on the distribution of administrative areas of each local government in Taiwan. Observation sites were constrained areas where dogs seldom visited, passed, or stopped by, such as areas surrounded by wide roads or rivers. This study included three surveys, respectively held in 1999, 2004, and 2009. In the first survey, a total of 56 observation sites were investigated. The second and third surveys included the same 74 observation sites (Figure 1). Because several urban construction projects were implemented in Taiwan from 1999 to 2003, some of the 56 observation sites in the first survey no longer existed in 2004 and 2009. For 4 days in each area, a surveyor rode a bicycle along a predetermined path in the designated area. Stray dogs were “captured and removed” using photographs. The number of stray dogs was estimated based on the number of total residents in the surveyed areas, the number of stray dogs in the surveyed areas, and the total human population of Taiwan (Table 2). The total number of stray dogs in Taiwan was estimated as  $(\text{Total human population of Taiwan}) / (\text{Total residents in surveyed areas} / \text{Total stray dogs in surveyed areas})$ .

The rationale behind the determination of the number of surveyed areas classified each city (or county) in Taiwan as a stratum, and each constrained area was eligible for running a photographic survey as a unit for sampling. Surveyed areas were selected using a stratified random-sampling method. For city (or county)  $i$ , let  $N_i$  be the total number of eligible constrained areas and let  $n_i$  be the number of constrained areas to be sampled. In addition, let  $N = \sum_i N_i$  and  $n = \sum_i n_i$  be the population size and the total sample size, respectively. Given that the cost of running a photographic survey in each area is the same, and assuming that stratum variances are approximately the same, the number of surveyed areas in each city (or county) is determined based on proportional allocation, specifically,  $n_i = n(N_i/N)$  (Scheaffer et al., 2006).

## 3. Data from animal shelters in Taiwan from 1999 to 2009

Currently, only public (not private) animal shelters in Taiwan are allowed to implement euthanasia.

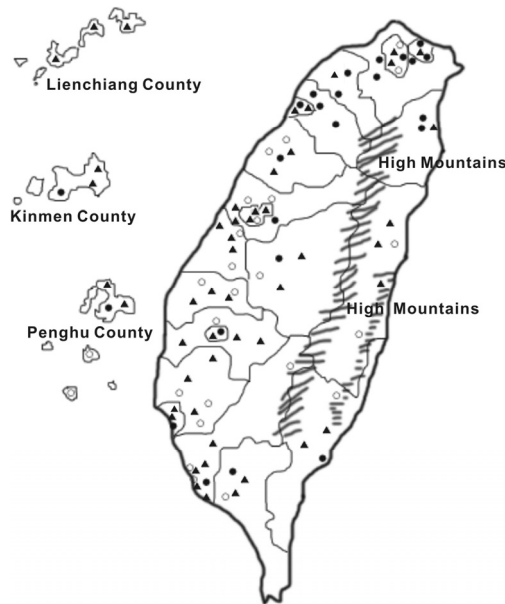


Figure 1 Areas of stray dog surveys in Taiwan. ○: Areas surveyed solely in 1999; ▲: Areas surveyed in 2004 and 2009; ●: Areas surveyed in 1999, 2004, and 2009.

All private shelters adopt no-kill policy (Lin and Fei, 2011). To date, because to provide operating information of private animal shelters to authority is not a legislative obligation, therefore only information on dogs entering and exiting public animal shelters were used. Most of the shelters use written documents to collect information. As a result, only the final data in the tables were calculated and recorded. The data used in this study were official national data provided by Council of Agriculture, Executive Yuan.

## RESULTS

### 1. Estimation of the national household dog population

Table 1 shows the data from six surveys on national household dog populations, including the number of household dogs per 100 people, and the percent of households that owned dogs between the years of 1999 and 2009. The trend of household-dog ownership rapidly declined until 2007, where the population increased slightly, but then declined again by 2009. The percent of households owning dogs in 1999 was 23.1%, and dropped below 20% between 2001 and 2009. However, the data in Table 1 indicated that from 1999 to 2009, the percentages of households owning one dog or two dogs, and the average number of dogs per dog-owning household were approximately the same. It shows that the decrease of total household dog population solely resulted from the decrease of dog ownership.

Table 1 Values of relevant origin and estimation process of the numbers of household dogs

Item	Years					
	1999	2001	2003	2005	2007	2009
Sample size in each survey = a	10,913	9,629	10,019	11,427	10,990	16,602
Confidence level	99%	99%	99%	99%	99%	99%
Surveyed households owning dogs = b	2,519	1,808	1,559	1,423	1,538	2,225
Percent of households owning dogs = c (b/a)	23.1 %	18.8 %	15.6 %	12.5 %	14.0 %	13.4 %
Households owning only one dog	72.4% (n=2,519)	71.4% (n=1,800)	70.9% (n=1,554)	71.2% (n=1,423)	72.2% (n=1,538)	72.2% (n=2,225)
Households owning only two dogs	14.5% (n=2,519)	15.2% (n=1,800)	16.8% (n=1,554)	15.2% (n=1,423)	14.4% (n=1,538)	15.2% (n=2,225)
Total number of dogs owned by surveyed families = d	3,931	2,785	2,347	2,177	2,386	3,341
Average number of dogs owned per family = e (d/b)	1.56	1.54	1.51	1.53	1.55	1.50
Total number of human household <sup>(1)</sup> = f	6,497,762	6,780,828	7,019,327	7,277,800	7,491,916	7,777,527
National household dogs number = g (c*e*f)	2,340,576	1,961,222	1,644,312	1,386,521	1,626,543	1,565,156
Taiwan human population <sup>(2)</sup>	22,048,356	22,368,502	22,573,965	22,744,839	22,925,311	23,086,441
Number of household dogs per 100 capita	10.6	8.8	7.3	6.1	7.1	6.8
Grant numbers	BAPHIQ-89-1.4-AP01	COA-90-4.6AD-01	COA-92-4.2AD-01	COA-94-4.1AD-01	COA-96-4.1AD-02	COA-98-4.1AD-05(28)

<sup>(1)</sup> Department of Household Registration, Ministry of the Interior. [http://www.ris.gov.tw/gateway/population.cgi?s\\_code=m1&sheet0name=s1](http://www.ris.gov.tw/gateway/population.cgi?s_code=m1&sheet0name=s1)

## 2. Evaluation of stray dogs in Taiwan

In three surveys conducted in 1999, 2004, and 2009, stray dog populations in 56, 74, and 74 constrained areas, respectively, were investigated. In these three surveys, the total number of dogs captured by photographs decreased from 3,756 dogs in 1999 to 1,429 dogs in 2009. The total number of residents within the constrained areas grew from 134,739 in 1999 to 401,708 residents, but decreased slightly in 2009 to 382,368. Similar to the total number of household dogs, the total number of stray dogs decreased significantly from 1999 to 2009. The number of stray dogs in 2009 was one-seventh of that in 1999 (86,244 vs. 613,959 dogs; Table 2). Likewise, the number of dogs per 100 capita at each survey dropped from 2.79 dogs per 100 capita in 1999 to 0.37 dogs per 100 people in 2009. These data clearly indicate a decline in the population of stray dogs in Taiwan.

Table 2 Analysis of stray dogs in Taiwan in 1999, 2004, and 2009.

Item	Year		
	1999	2004	2009
Total number of surveyed areas	56	74	74
Total photographically captured dogs (a)	3,756	2,137	1,429
Total residents in surveyed areas (b)	134,739	401,708	382,368
Resident/dog ratio (c=b/a)	35.87	187.98	267.58
Total human population <sup>(1)</sup> (d)	22,022,715	22,647,160	23,077,191
Total estimated stray dogs (e=d/c)	613,959	120,476	86,244
Stray dogs per 100 capita (f=100e/d)	2.79	0.53	0.37

<sup>(1)</sup>Human population of Taiwan in July when stray dogs were photographed.

## 3. Animal shelters in Taiwan

As shown in Table 3, the dogs entering public animal shelters in Taiwan were either captured by animal control officers or surrendered by owners. As shown in Table 3, from 1999 to 2009, approximately 80% of the dogs entering animal shelters were captured by animal control officers. Dogs exited public animal shelters through euthanasia, adoption, or reclamation. More than 70% of the dogs exited shelters as a result of euthanasia during the 10 years of this study. The total number of dogs entering and exiting shelters consistently increased after 2006. However, the rates of adoption, reclamation, and surrender remained approximately unchanged. Figure 2 illustrates the inverse relationship of the number of stray dogs with the number of dogs entering national shelters and the number of euthanatized dogs between 1999 and 2009.

## DISCUSSION

In Taiwan, only approximately 2.1-2.8% of households own cats, whereas the percent of households that own dogs is much higher (Table 1). Therefore, dogs are the primary household pets in Taiwan. Furthermore, dogs comprise the large majority of animals in animal shelters.

Table 3 Annual dog shelter records from 1999 to 2009 in Taiwan

Year	Entering shelters	Captured by ACO <sup>(1)</sup>	Surrendered	Exiting shelters	Adopted	Reclaimed	Euthanized
1999	78,686	78,686	No record	76,131	2,920	2,980	70,231
2000	65,636	63,358	2,278	57,693	7,292	2,408	47,993
2001	59,225	53,760	5,465	46,049	8,466	1,795	35,788
2002	68,018	59,140	8,878	56,076	11,537	2,317	42,222
2003	78,716	65,231	13,485	69,922	13,479	2,488	53,955
2004	85,923	73,288	12,635	76,764	13,405	2,845	60,514
2005	71,161	59,683	11,478	62,483	10,597	No record	51,886
2006	83,704	70,998	12,706	75,892	11,743	No record	64,149
2007	97,135	81,801	14,580	84,880	12,215	2,017	70,648
2008	107,375	91,273	14,422	88,268	12,752	2,511	73,005
2009	127,023	108,406	16,611	111,855	14,909	2,506	94,440
Total	922,602	805,624	112,538	806,013	119,315	21,867	664,831

(1) ACO, Animal Control Officer.

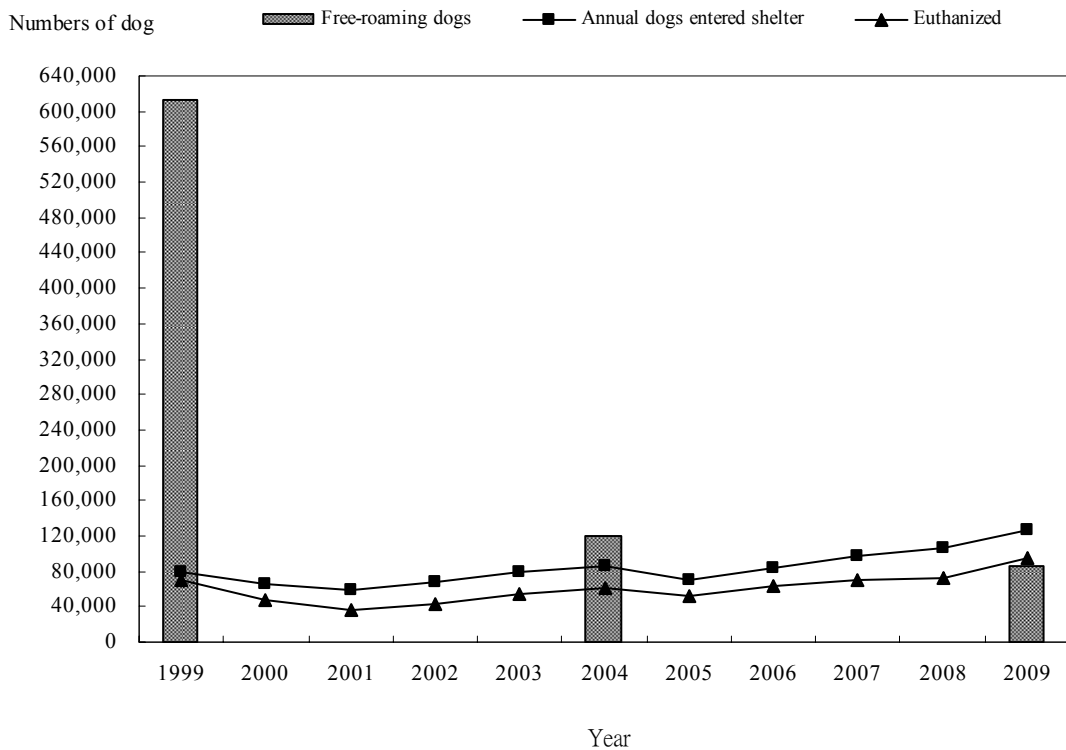


Figure 2 Populations of stray dogs, dogs entering shelters, and dogs euthanized in shelters in Taiwan between 1999 and 2009.

## 1. Number of total household dogs

The total number of household dogs between 2003 and 2008 in three Asian countries, Japan, Singapore, and Hong Kong, constantly increased (Euromonitor International, 2008a; Euromonitor International, 2008b; Euromonitor International, 2008c). From 1996 to 2006, the total number of household dogs in the United States also increased (American Veterinary Medical Association, 2007). However, the number of total household dogs in Taiwan declined after 1999 and increased only slightly in 2007.

A previous study suggested that the increase in the number of household dogs was caused mainly by good socioeconomic capacity (Selby et al., 1980; Covert et al., 1985). Although it is easier for people with good economic capacity to keep dogs as pets, when the life value of dogs increases in the mind of the owners, the owners will appropriate budgets for pets even during economic difficulties. After the financial crisis in 2008, the global economy significantly decreased and personal income generally declined. However, as compared with 2007, the consumption of pet food and pet care products in 2008 conversely increased by 33.0 million Renminbi in China, 17.4 billion Japanese Yen, and 2.9 million Singapore dollars (Euromonitor International, 2008a; Euromonitor International, 2008b; Euromonitor International, 2008c). Therefore, the consumption of pet food and pet care products increased during a time that incomes generally decreased. It has been suggested that due to current social trends that include stronger focus on careers and marrying later in life, pets have naturally become the important companion of their owners. Therefore, owners attach increasing importance to their pets' wellbeing. This standard has even raised pets to that of their owner, thereby contributing to the new phenomenon of pet humanization. As a result, the retail value of premium pet food does not decrease with economic recession, but increases instead. The increase in the consumption of dog and cat food is most significant (Euromonitor International, 2008a; Euromonitor International, 2008b; Euromonitor International, 2008c).

In addition, the decrease of household dogs is associated with the economic development. According to Selby et al. (1980), there is a positive correlation between prevalence of pet ownership and personal incomes. Covert et al. (1985) also suggested that there is a positive correlation between the household incomes and the pet ownership; but household pets are not related to the area of residence (city or rural area). Similarly, the decrease of household dogs in Taiwan is associated with the decrease of national incomes and growth of prices of commodities in recent years. In addition, it takes time, patience and money to raise dogs. Some owners tend to abandon or send the dogs to shelters due to space of houses, time, income, mandatory responsibilities of the Animal Protection Act, and the growth or barking of dogs. Therefore, in Chapter 7 of the Terrestrial Animal Health Regulation in World Organization for Animal Health, "responsible owners" are emphasized (World Organization for Animal Health, 2009).

This study indicated that, in the recent decade, the number of total household dogs in Taiwan, the number of dogs per 100 capita, and the percentage of households that own dogs consistently decreased, except between 2007 and 2009. This trend was opposite of that observed in Hong Kong, Singapore, Japan, and the United States (American Veterinary Medical Association, 2007). Therefore, this study suggested that several possible concepts of human animal bond as reported by Selby et al (1980) have negatively



influenced with pets ownership. In the case of Taiwan, it needs more studies on the subjects at: housing limitations, emotional dissatisfaction with animals, destructive habits of pets, and a transient household status. However, such a concept was not introduced to Taiwan until much later than in Hong Kong, Singapore, Japan, and the United States. However, because the Taiwanese concept of the value of animal life has begun to increase, many people may be more cautious about dog ownership. Some people may relinquish their household dog because they cannot fulfill the responsibility. Additionally, some potential household-dog owners may hesitate to own a dog for similar reasons.

## **2. Estimations of stray and sheltered dogs**

There are two methods for calculating stray dogs: wildlife techniques and anthropological inquires (WHO/WSPA, 1990). Taiwan has a total land area of 36,008 km<sup>2</sup> (Minister of the Interior, 2011). Wild animal groups such as raccoons, skunks, foxes, and canids are not present as endemic species in Taiwan (Endemic Species Research Institute, 2011; Taiwan Biodiversity Information Facility, 2011). There are no canids present in non-urban areas; therefore, this study did not survey non-urban areas (Figure 1). This study used anthropological inquires to calculate the number of stray dogs in urban areas. The category of “stray dogs” in this study included unsupervised owned-dogs, loose dogs, latchkey dogs, lost owned-dogs, community dogs, family dogs, neighborhood dogs, street dogs, and free-ranging dogs (Beck, 2002; Knobel et al., 2007; World Organization for Animal Health, 2009). Many factors may have contributed to the significant decrease in the number of stray dogs because that population is associated with or influenced by the populations of household dogs, abandoned dogs, unsupervised owned-dogs, dogs in shelters, dogs that died on streets due to illness or accident, and dogs in pet shops and breeders (Boitani et al., 1995; International Companion Animal Management Coalition, 2007). The difference in any of those populations would be associated with the number of stray dogs. In this study, records from public animal shelters and other dog populations were incomplete. Therefore, changes in those populations could not be included in the cause and effect analysis of this study.

As shown in Table 2, Table 3, and Figure 2, the number of stray dogs in Taiwan constantly declined from 1999 to 2009. Approximately 82% of the dogs entering shelters were captured by animal control officers (Table 3), while other dogs (<17.1%) entered shelters as a result of surrender. As shown in Table 2, the number of stray dogs decreased by approximately 500,000 from 1999 to 2009. However, the number of stray dogs captured by animal control officers from 1999 to 2009 only increased by 30,000 (Table 3, Figure 2). Therefore, in the recent decade, the decrease in the number of stray dogs is only partially due to capture by animal control officers. Moreover, the increased number of dogs in animal shelters in recent years suggests that shelters have taken increased responsibility for resolving the problem of pet overpopulation.

The EPA has improved garbage disposal regimes to reduce the amount of waste foods available to strays throughout the whole country. These efforts have likely contributed to the reduction of the stray dog population (Hsu et al., 2003) because that population is dependent on three resources: food, water, and shelter. The food source for stray dogs is considered to be waste food. Theoretically, if access to both

garbage and waste food is eliminated, stray dogs would only have limited food resources, which would then likely result in a significant decrease in the number of stray dogs (Wandeler et al., 1988; WHO/WSPA, 1990; Beck, 2002; Kato et al., 2003).

### 3. Number of dogs in animal shelters

There were more private animal shelters in Taiwan than public shelters during the decade of study. However, except for a few organizations with support from animal protection organizations in western countries, such as the Taiwan Society for the Prevention of Cruelty to Animals (Taiwan SPCA), none of the local private animal protection organizations or animal shelters publicly approved or allowed to implement euthanasia. Dogs in private shelters, if not adopted, would always stay there for the whole life (Lin and Fei, 2011). Consequently, the private animal shelters do not balanced the flow of dogs abandoned from household dog population very much. However, as previously stated by Zawistowski et al. (1998), because specifications and systems for managing private animal shelters have not been established and since the government has not requested private animal shelters to record information in unified quantitative forms, it is difficult to conduct relevant in-depth studies.

Studies of pet overpopulation require dynamic information on dog populations, including populations of household dogs, stray dogs, those entering and exiting public and private animal shelters, dogs in breeding organizations, dogs in pet shops, and death rates of stray dogs. This study investigated three of these categories, namely dog populations in public animal shelters, household dogs, and stray dogs. As stated in Resolution No. XIV of the OIE during its 70th General Session in 2002, Animal welfare is a complex, multi-faceted public policy issue that includes important scientific, ethical, economic and political dimensions, the OIE develop a detailed vision and strategy to incorporate, balance and take account of these dimensions (World Organization for Animal Health, 2002). Consequently, the causes for the change in the number of dogs also included moral concerns. In recent years, increasing importance has been attached to moral values (Haslam, 2005), and human empathy for animals has increased, which has changed the attitude toward interactions with animals and may be one of the causes for the changes in the number of dogs in Taiwan.

According to ICAM (International Companion Animal Management Coalition, 2007) and data in this study, relationship among numbers of household dogs, stray dogs and shelters is shown below : (1) sources of household dogs include: purchase from dog shops, return after being missing, and adoption; in Taiwan, it also includes private breeding and gifts from friends. The causes of the decrease of household dogs include abandoning and missing; in Taiwan, it also includes the gifts to others; (2) sources of stray dogs include missing household dogs, abandoned household dogs, and stray dogs' breeding; the causes of the decrease of stray dogs include capture, death, and adoption; (3) sources of sheltered dogs include capture by animal protectors, found by the public, or abandoning; the causes of the decrease of sheltered dogs include mercy killing, adoption, return, and death. In addition, private animal shelters and feeding of stray dogs in the community are not included in this survey. Due to the reasons above, the cause and effect regarding numbers of household dogs, shelters and stray dogs cannot be precisely indicated.

This study collected statistical information on the number of dogs in Taiwan to provide data necessary for future studies. These studies may include studies on the risks of rabies in Taiwan, and measurement of equipment and supplies required for a rabies contingency plan. Moreover, this study also proposes possible reasons for the changes seen in the dog populations in Taiwan during the last decade.

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# 1999 年至 2009 年台灣狗數調查

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**摘要：**本研究是調查台灣從 1999 年到 2009 年全國的家狗數、流浪狗數及進出動物收容所狗數之研究。台灣自 1999 年起每二年進行一次全國家狗數之調查，每五年進行一次全國流浪狗數之調查，進出動物收容所狗數是從政府的文件取得。家狗數的調查採用電話問卷方式，每一次調查的問卷數均超過 9,600 份。流浪狗的調查採用「照相捕捉法」，1999 年在 56 個區域進行照相捕捉，2004 年及 2009 年間在 74 區域進行照相捕捉。研究結果顯示：家狗數從 1999 年 2,340,576 隻快速減少至 2009 年的 1,565,156 隻。流浪狗數量也從 1999 年的 613,959 隻快速減少到 2004 年的 120,476 隻，之後減少到 2009 年的 86,244 隻。台灣每年進入動物收容所的數量從 1999 年 78,686 隻增加至 2009 年的 127,023 隻，安樂死狗數從 1999 年 70,231 隻增加至 2009 年的 94,440 隻。本研究的相關數據可提供狂犬病的防治計畫或狗口數控制等相關研究之使用。

(關鍵語：動物收容所、狗數、家狗、流浪狗、台灣)

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