<Original Article>

Data analysis for improving population management in animal shelters in Seoul

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Abstract : A total of 11,395 animals were impounded in shelters in Seoul in 2013. The Animal Protection Division of the Seoul metropolitan government has annual contracts with local veterinary associations as well as Korean animal rescue and management organizations for providing shelter to animals, and collects monthly statistics from these groups. In 2013, the collected intake and outcome data for 25 districts were reviewed to analyze shelter capacity in terms of housing capacity (monthly daily average intake, required holding capacity, and adoption-driven capacity), staff capacity (staff hours required for daily care), and live release rate. Seasonal variations in the monthly daily average intake were observed, indicating that management of these shelters requires various strategies. This study was performed to analyze and interpret meaningful statistics for improving the efficiency of animal shelters in Seoul. However, inconsistent collection of animal statistics limited data compilation. Creation of a basic animal statistics matrix with reference to well-designed matrices from recognized professional animal shelters is essential. These complied statistical data will help plan for future animal shelter needs in Seoul.

Keywords : animal shelters, animal statistics, animal welfare, population management, shelter medicine

Introduction

A total of 11,395 animals were impounded in animal shelters in Seoul city in 2013: 7,765 dogs, 3,269 cats, and 361 other animals. The average length of stay was 12 days before a decision was made about the outcome of each sheltered animal. A budget of 1,086 million Korean won was allocated for animal sheltering services, with an average cost of 95 thousand Korean won per animal. Shelter services in the Seoul metropolitan government have evolved over the years. The services provided by these shelters include the collection and sheltering of stray animals, rabies control for public health, reunion of lost pets with missing owners, pet adoptions, and humane euthanasia of sick or injured animals. Research on the risk factors for relinquishment has revealed that animal behavior problems are strongly associated with the risk of relinquishment, along with the cost of care, moving, and other human household issues [8, 10, 14, 15]. In the future, shelters in Seoul need to offer food pantries and lists of rental properties as well as animal behavior helplines [7, 9]. In addition, a well-organized animal-sheltering program should enforce laws related to public health and safety; investi-

gate complaints of animal cruelty, abuse, and neglect; promote mandatory identification of both dogs and cats; create incentives for the public to get their pets sterilized; and deter future problems through education programs based on professional shelter medicine [6]. Korean society is not familiar with shelter medicine. Unlike conventional small animal practices, shelter medicine must address the well-being of entire populations as well as individual dogs and cats in the context of unique shelter environments [13]. The goal of shelter medicine is to release healthy animals into the community and decrease the number of homeless animals in the community [13].

The Animal Protection Division in Seoul has administered animal control and covered the funding for sheltering services. In 2013, the Animal Protection Division gave contracts to local veterinary medical associations in 6 districts and the Korea Animal Rescue and Management Association (KARMA) in 19 districts for providing animal shelter services, and it has been collecting monthly statistics from these 25 districts. The Seoul metropolitan government has plans to own and operate the animal shelters and provide the associated services. Well-organized shelters need to have active population management based on up-to-date shelter statis-

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tics. Population management is one of the critical components of shelter medicine. Population management refers to active and intentional guidance or control to save lives, preserve health, provide care, and help solve the problems that bring the animals to the shelter [12]. Animal and Plant Quarantine Agency has made annual reports about animal sheltering throughout the country [1]. These reports include the only yearly calculations of intake and outcome numbers by region. Although rough estimates can be obtained using annual numbers, it is more effective to understand and maintain adequate capacity for care and housing on monthly basis. There is however no studies estimating capacity for care by using animal numbers of intake and outcome in animal shelters in Seoul. For the better management of future populations in Seoul municipal shelters, we recommend the development of a centralized and uniform method for collecting and reporting shelter data from each of the 25 districts. With such data, we will be able to make better use of resources and target interventions to humanely decrease the number of strays in the city. This study aimed to calculate and interpret meaningful statistics for maintaining adequate capacity for care of animal shelters in Seoul.

Materials and Methods

Study community

Seoul is the capital of South Korea, its chief industrial center, and the largest city in the nation encompassing an area of 605.20 km^2. The municipality is predominantly residential, but it also contains substantial industrial, commercial, and recreational areas. According to the Seoul Statistical Yearbook 2014, Seoul had a population of 10.39 million inhabitants, with a density of 17,163/ km^2 in 2013. Seoul is divided into 25 districts (autonomous *gu*). The *gu* vary greatly in area (from 10 to 47 km^2) and population (from fewer than 138,000 to 675,000) [18].

Terminology

The definitions of the terms used in this study are as follows [12].

The term intake includes the number of strays, surrenders, and transfers. The term *outcome* includes the number of reclaims, adoptions, transfers, and euthanasia episodes.

The monthly daily average (MDA) for intake and outcomes is calculated by obtaining the monthly total and dividing it by the number of days in the month.

The intake holding period for stray animals is 10 days according to the Korean Animal Welfare Act. At the end of the legally required holding period, animals are available for adoption, rescue, or euthanasia.

The required physical holding capacity (RHC) refers to the number of housing units required to hold animals for any period required by law or policy. RHC depends on both the type of housing and the type of animal to be housed. RHC is calculated by multiplying the MDA intake with the required holding period.

The adoption-driven capacity (ADC) refers to the optimal number of animals that are either actively available for adoption or to be assigned to an adoption pathway. ADC is calculated by determining the target average length of stay and multiplying the value with the MDA number of adoptions. The total target average length of stay should generally be approximately 2 weeks or less, including holding and adoption. The legal holding time for strays is 10 days, and holding areas are cut off from public view in South Korea. Therefore, the total target length of stay was set at 17 days so that the target time in adoption was 7 days in this study.

The live release rate (LRR) is the proportion (*e.g.*, reclaims, adoptions, and transfers) of animals leaving the shelter alive during a given period from those that entered the shelter during that period.

The staff capacity for daily care (SCDC) is the total number of animals that can be cared for humanely and adequately on a daily basis. SCDC is calculated by dividing the number of staff minutes available for basic care activities per day by the number of minutes required per animal. Basic care activities must include daily cleaning, feeding, any needed medical care, and monitoring of each animal.

The required staffing capacity for daily care (RSDC) is calculated by multiplying the number of animals present on a daily basis with the number of minutes required for basic care per animal per day and dividing the obtained value by 60. The minutes required for basic care per animal per day can vary with species, age, housing type, and population needs. The National Animal Control Association (Determining kennel staffing levels, 2014) and the Humane Society of the United States (General staffing recommendations for kennel caretaking, 2010) recommend 15 min per animal per day for basic care (9 min for cleaning and 6 min for feeding).

The staff capacity for flow-through is the ability to provide each animal with required specific services at several points during their shelter stay, such as intake, behavioral evaluation, spay/neuter surgery, and processing for reclaim, pre-adoption health testing, or physical movement to adoption, transfer, or euthanasia.

Statistical analysis

Intake and outcome (*e.g.*, rates of reclaims, adoptions, transfers, died in care, and euthanasia) data for 2013 were collected for both cats and dogs from the Animal Protection Division in Seoul. For year-to-year comparisons, annual reports were gathered from the Animal Protection Management System (APMS) [1]. The APMS data represented combined intake and outcome data for dogs, cats, and other animals. In this study, the use of the term *animals* will pertain only to dogs and cats.

Results

Housing capacity

The annual average MDA was 21 for dogs and 9 for cats

Table 1. Required holding capacity and adoption-driven capacity values for dogs in animal shelters in Seoul in 2013

A	B	C	D	E	F	G	H	I
Time period	Intake	Days each month	MDA intake[*]	Intake holding period	RHC[†]	Adoptions	MDA adoptions	ADC[‡]
Jan	465	31	15	10	150	145	5	33
Feb	442	28	16	10	158	138	5	35
Mar	644	31	21	10	208	186	6	42
Apr	650	30	22	10	217	153	5	36
May	811	31	26	10	262	151	5	34
Jun	775	30	26	10	258	158	5	37
Jul	840	31	27	10	271	159	5	36
Aug	884	31	29	10	285	153	5	35
Sep	662	30	22	10	221	127	4	30
Oct	587	31	19	10	189	125	4	28
Nov	556	30	19	10	185	134	4	31
Dec	449	31	14	10	145	123	4	28
Total	7765	365	255	120	2549	1752	58	403
Avg	647	30	21	10	212	146	5	34

[*]Monthly daily averages, where column D = column B/column C. [†]Required physical holding capacity, where column F = column D × column E. [‡]Adoption-driven capacity, where column I = column H × a 7-day target length of stay in adoption (this would apply to a shelter where animals are also available for a 10-day intake holding period, resulting in an overall average length of stay of 17 days).

Table 2. Required holding capacity and adoption-driven capacity values for cats in animal shelters in Seoul in 2013

A	B	C	D	E	F	G	H	I
Time period	Intake	Days each month	MDA intake[*]	Intake holding period	RHC[†]	Adoptions	MDA adoptions	ADC[‡]
Jan	138	31	4	10	45	49	2	11
Feb	134	28	5	10	48	38	1	10
Mar	138	31	4	10	45	51	2	12
Apr	198	30	7	10	66	66	2	15
May	524	31	17	10	169	196	6	44
Jun	470	30	16	10	157	99	3	23
Jul	462	31	15	10	149	111	4	25
Aug	291	31	9	10	94	75	2	17
Sep	249	30	8	10	83	73	2	17
Oct	314	31	10	10	101	90	3	20
Nov	211	30	7	10	70	71	2	17
Dec	140	31	5	10	45	44	1	10
Total	3269	365	107	120	1071	963	32	221
Avg	272	30	9	10	89	80	3	18

[*]Monthly daily averages, where column D = column B/column C. [†]Required physical holding capacity, where column F = column D × column E. [‡]Adoption-driven capacity, where column I = column H × a 7-days target length of stay in adoption (this would apply to a shelter where animals are also available for a 10-day intake holding period, resulting in an overall average length of stay of 17 days).

(Tables 1 and 2); these values are lower than the peak daily intakes of 29 and 17, respectively. The high numbers were observed from May through August for dogs and from May through July for cats. From November through April, 7 or fewer cats came in daily, less than half the peak number. The average RHC and RHC for the peak season was 212 and 258 to 285, respectively, for dogs. The corresponding values were 89 and 149 to 169, respectively, for cats. Tables 1 and 2 show

Table 3. Required staffing hours for daily care and the live release rate every month in animal shelters in Seoul in 2013

A	Dogs				Cats			
	B	C	D	E	F	G	H	I
Time period	Intake	RHC	RSDC[*]	LRR[†]	Intake	RHC	RSDC[*]	LRR[†]
Jan	465	150	38	51	138	45	11	41
Feb	442	158	39	53	134	48	12	33
Mar	644	208	52	50	138	45	11	38
Apr	650	217	54	50	198	66	17	36
May	811	262	65	48	524	169	42	37
Jun	775	258	65	48	470	157	39	24
Jul	840	271	68	48	462	149	37	27
Aug	884	285	71	45	291	94	23	28
Sep	662	221	55	50	249	83	21	29
Oct	587	189	47	52	314	101	25	28
Nov	556	185	46	50	211	70	18	35
Dec	449	145	36	55	140	45	11	31
Total	7765	2549	637	NA	3269	1071	268	NA
Avg	647	212	53	50	272	89	22	32

[*]Required staffing hours for daily care, where column D (or H) = 15 min × column C (or G)/60. [†]Live Release Rate, where column E = number of reclaims, adoptions, and transfers/number of intakes.

that RHCs for the peak season were higher than those for the slower intake months.

The average MDA number of adoptions was 5 for dogs and 3 for cats. Cat adoption increased from May to July. The ideal number of animals for adoption, ADC, is calculated by multiplying the target average length of stay in adoption with the MDA number of adoptions. The target average length of stay was determined to be 17 days, including 10 days for the intake holding period and 7 days for the target time in the adoption room. The average ADC was 34 for dogs and 18 for cats.

Staff capacity

As shown in Table 3, the required staff hours for daily care (RSDC) were calculated by multiplying the number of minutes required for basic care per animal per day with the number of animals present on a daily basis (RHC) and dividing the obtained value by 60. In peak season, RSDC was 65 to 71 hours for dogs and 37 to 42 hours for cats, while the average value was 53 hours for dogs and 22 hours for cats. We can calculate the number of kennel staff to be approximately 23, because basic care should be completed within 3 to 4 hours before the shelter is opened to the public.

LRR

In Table 3, the average LRR (32%) for cats was less than that (50%) for dogs. LRR tended to decrease slightly during peak season. Many dogs were euthanized through May to August (Fig. 1). Although the cat adoption rate increased through May to July, many cats died in care or were euthanized during the same period.
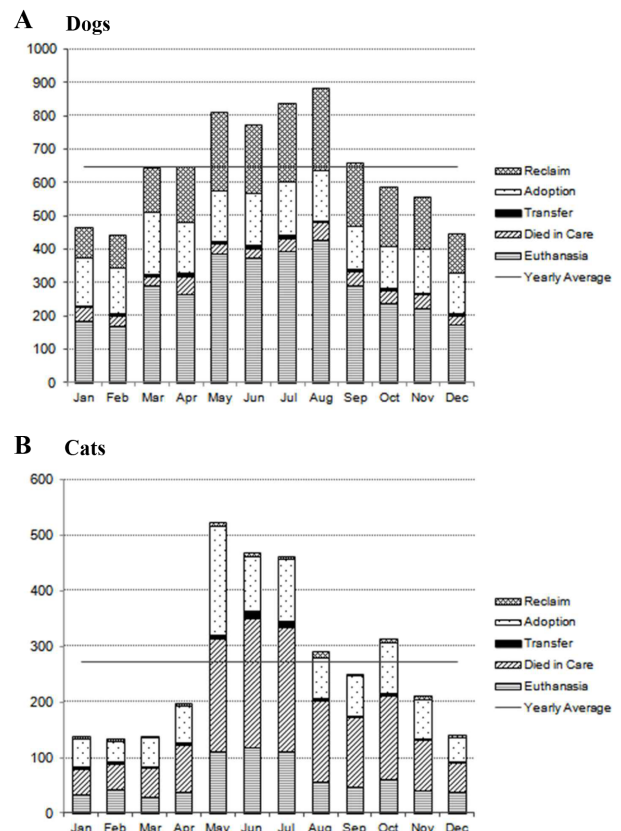
Fig. 1. Yearly versus monthly outcomes of dogs and cats in Seoul, 2013.

We compared shelter intake and outcome data through 2011 to 2013 (Fig. 2). Shelter intake was 13,792 in 2011 and
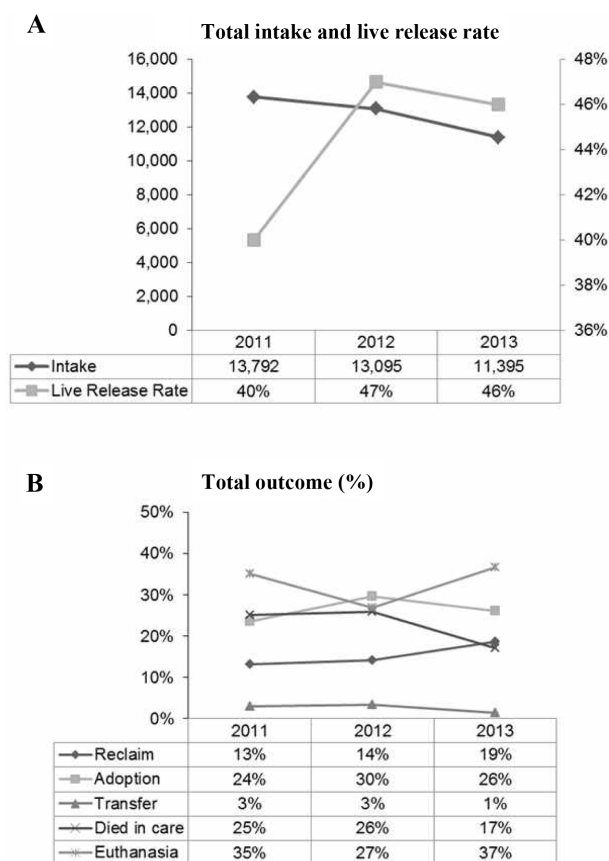
A

Total intake and live release rate

	2011	2012	2013
Intake	13,792	13,095	11,395
Live Release Rate	40%	47%	46%

B

Total outcome (%)

	2011	2012	2013
Reclaim	13%	14%	19%
Adoption	24%	30%	26%
Transfer	3%	3%	1%
Died in care	25%	26%	17%
Euthanasia	35%	27%	37%

Fig. 2. Year-to-year comparison of outcomes in dogs, cats, and other animals in Seoul.

11,395 in 2013. LRR was 40% in 2011, 47% in 2012, and 46% in 2013 (Fig. 2A). Adoption (26%) and transfer (1%) rates in 2013 were lower than those (30% and 3%, respectively) in 2012. The euthanasia rate (37%) in 2013 was higher than that (27%) in 2012, whereas the rate of died in care (17%) in 2013 was lower than that (26%) in 2012 (Fig. 2B). The decrease in shelter intake was not accompanied by an increase in LRR.

Discussion

This study shows the appropriate calculation and interpretation of meaningful statistics for efficient population management in animal shelters in Seoul. Capacity can be calculated using monthly reports of intakes by type (*e.g.* stray, surrender, and transfer) and outcome number by type (*e.g.* reclaim, adoption, transfer, and euthanasia) [17]. Because housing, daily care, ADC, and staff capacity for flow-through may differ between puppies and kittens and between dogs and cats, calculating and considering holding requirements according to age is particularly important. Capacity requirements for variations in breed and size must be considered separately because different-sized housing requirements may be required [12]. At the minimum, statistics must include the

monthly intake by source, outcome by type, and daily animal census. In addition, statistics should ideally include evaluation by age group, health, and behavior status at intake and outcome [11]. Therefore, the Animal Protection Division in Seoul needs to create a basic animal statistics matrix with reference to well-designed matrices like as Asilomar Accords and Basic Data Matrix of National Federation of Humane Societies.

Animal Protection Management System has reported annual sheltered animals [1]. However it is more effective to look at capacity trends and variability on monthly basis, because especially cat intake tends to be seasonally variation [12]. The seasonal variations were observed in the MDA intake, particularly from May through August for dogs and from May through July for cats. For planning or retrofitting of shelters in Seoul, sufficient capacity for peak populations should always be considered. It would be much more effective to temporarily increase the animal intake and care staff for the peak month rather than maintaining a consistent staff level throughout the year. A decrease in staff during peak season could be addressed through the recruitment of a skilled volunteer work force or investment in less labor-intensive systems.

Shelters in Seoul showed a tendency to be unaware of their maximum RHC by conducting interviews for this study. In other words, they have little understanding of the number of actual kennels or runs to meet RHC in Seoul shelters. In peak season, it creates operating beyond capacity like as delays or failure to provide necessary care, use of substandard housing, haphazard mixing of animals, and increases of negative outcome. Chronic overpopulation causes high levels of stress and disease in sheltered animals [16]. In addition, insufficient capacity for housing and care results in chronic staff shortage and insufficient adoption space [12]. Therefore, Seoul government needs to be informed of the calculation for the MDA population and the number of humane housing units from shelters. The calculations described in this study are based on averages, but even within a month, there will be some variations such as the day of reopening or transfer of animals from another shelter. Therefore, daily data for every month should be acquired through daily rounds.

While dog adoption did not show seasonal fluctuations, cat adoption increased from May through July in 2013. The increased adoption rate during these months was probably related to the birth of many kittens during the kitten season. Factors that influence the rate of adoption and waiting time before adoption are diverse [4]. The age of cats is one of the important factors affecting adoption [5]. Kittens appeal to a broad range of adopters and have no particular barriers to adoption. Animals that move through the shelter system quickly are referred to as fast-track animals. The development of a system for identifying fast-track animals can help in decreasing the congestion in pre-adoption areas and the daily population and increasing LRR [12]. Minimizing the length of stay in the shelter is the key to decreasing disease

transmission, such as like feline upper respiratory tract disease [2, 3]. In addition, animals in most shelters are held as stray animals or in quarantine in areas where they cannot be viewed and selected for adoption. If animals in holding are made available for adoption throughout their stay, the problems of lack of housing space and insufficient adoption staff can be resolved.

We could not calculate SCDC because precise staff minutes for basic care activities per day were not available. If the actual daily population exceeded SCDC, failures in care would be nearly inevitable. Similar to insufficient housing in Seoul animal shelters, this would have led to a struggle to just feed and clean, creating considerable stress for the staff. Even though SCDC is theoretically sufficient, insufficient staffing for each flow-through point can slow down operations and lead to vicious cycles in all other areas. Common critical flow-through points include intake, spay/neuter surgery, behavioral evaluation, preadoption health testing, adoption, and euthanasia. Flow-through staffing can be determined for these points by observation. If the estimated adequate staff for flow-through is not provided, then the abovementioned process needs to be shortened or the number of animals requiring these services needs to be decreased by decreasing intake [12].

A total of 1,449 (44%) cats died in care while 732 (22%) were euthanized in 2013. This indicates that several cats suffered and died in the shelter. Sheltered cats should be provided with appropriate physical check-ups and veterinary care. Veterinary staff at shelters should decide timely humane endpoints for euthanasia of suffering animals. To this end, animal shelters need shelter veterinarian trained in population management and shelter medicine to look after the physical health of shelter animals, enhance the behavioral health of shelter animals, protect community and public health, alleviate companion animal homelessness, and serve as a resource on animal and public policies [19]. Unlike conventional animal veterinary medicine, shelter medicine deals with production medicine and herd health. Although shelter medicine has traditionally been overlooked as a practice area in the field of veterinary medicine for less than two decades, Shelter Medicine Practice was recognized as a specialty by the American Board of Veterinary Practitioners after recommendation from the American Veterinary Medical Association's American Board of Veterinary Specialties on April 2014. Therefore, we require an education program to train shelter veterinarian and staff that provide science-based recommendations about the health and welfare of homeless animals.

The Animal Protection Division of Seoul should set up a master plan for planning and retrofitting animal shelters in the future. In the short term, they should improve inappropriate animal housing systems and methods of grant payments and fundraising campaigns and provide high-quality veterinary care. In the medium term, they should change shelter management systems for shortening the length of stay and increasing LRR. In the long term, they should extend humane

housing capacity and decrease intake through spay/neuter programs and education programs. To achieve these goals, past and present shelter statistics should be accurately analyzed and the significance of data collection and population management plans should be understood.

Seoul government has annually made contracts to different local veterinary medical associations and KARMA for animal sheltering. KARMA contracted animal sheltering to 15 districts in 2012 and 19 districts in 2013. Because local veterinary medical associations and KARMA have little veterinarian and staffs assumed full charge of animal sheltering, this retrospective analysis of shelter records was limited by insufficient data and the inability to identify staff capacity for daily care and staff capacity for flow-through. For gathering meaningful statistics, Seoul government needs to create the uniform animal statistics matrix. Animal shelters in Seoul need to gather more sufficient data, such as age, detailed intake type, and staff capacity for each flow-through point. In addition, animal shelters need to implement thorough intake process and daily rounds and provide appropriate veterinary care. This study will provide the initial data for estimating capacity of the animal shelters under direct management of Seoul government.

Acknowledgments

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