The Impacts of the City and County of Denver's Breed Specific Legislation

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Abbreviations

BSL - Breed Specific Legislation
CPI - Consumer Price Index
DAP - Denver Animal Protection
DAS - Denver Animal Shelter
PBTD - Pit Bull Type Dog
LOS – Length of Stay

Executive Summary

In August of 1989, the City and County of Denver, CO, USA enacted legislation that prohibits the presence of all “pit bull” type dogs (PBTD) (defined in Denver as: American Pit Bull Terrier, American Staffordshire Terrier, or Staffordshire Bull Terrier) within the city limits. In the 30 years the “pit bull ban” has been in place, the City and County of Denver and its animal control agency, Denver Animal Protection, have committed substantial resources to removing PBTDs from the community, including patrolling communities and/or responding to complaints made by neighbors, conducting thorough breed evaluations of suspected PBTDs, and kenneling PBTDs found in the city limits. This Social-Environmental-Economic Impact Assessment (SEEIA) examines how the City and County of Denver’s Breed-Specific Legislation (BSL) policy has impacted the economic and social systems of the Denver community.

An economic assessment of BSL identified that the City and County of Denver has spent at least $5.8 million on enforcing the legislation, with additional economic analyses estimating that BSL resulted in approximately $107 million in lost direct and indirect economic activity related to lost pet care revenue. BSL in the City and County Denver has resulted in an extended length of stay for PBTDs in the care of animal shelters and also places undue strain on transfer partnerships with shelters in surrounding communities. An estimated $1 million has been spent by shelters in surrounding communities to care for the PBTDs that are transferred as a result of BSL. An assessment of the social impacts of BSL determined that the removal of a single breed of dog is inconsistent with the documented benefits of increasing opportunities for pet-keeping in community. Furthermore, the disproportionate enforcement of BSL in underserved communities and communities of color perpetuates historic trends of discrimination and marginalization in the U.S. and negatively impacts social cohesion of these communities.

Despite some of the more negative impacts of the legislation, there appear to be a number of social factors that have sustained Denver’s “pit bull” ban. While in the minority of opinions, 19.4% of Denver residents who participated in an online survey about BSL (n = 252) said that the City and County of Denver’s breed ban positively impacted their perception of Denver and 24.6% of Denver residents said that the breed ban makes them feel safer. This perceived increase in sense of safety, even if only reported for a minority percentage of Denver residents, may continue to serve as the primary reason for policymakers to continue the ban in the present day (Maher, 2009, September 24).

The breed ban’s prioritization of human public safety at the expense of the welfare of a specific type of dog, particularly without a substantial impact on the former, represents a diversion from the components that contribute to a Humane Community. In conclusion, we recommend alternatives to BSL that will address the root causes of the issue of dangerous dogs, including: building the City and County of Denver's capacity to support residents in caring for their pets by identifying and expanding pet-support infrastructure such as affordable and accessible veterinary and behavior services, implementing robust non-breed-specific dangerous dog laws that include opportunities for early pet education and intervention with at-risk individuals, and implementing evidence-based interventions for challenges to social cohesion and interpersonal and interspecies violence.

Introduction

A Humane Community, as defined by the University of Denver's Institute for Human-Animal Connection (IHAC), is characterized by the presence of leadership, institutions, and policies working collaboratively across systems to create and implement sustainable human, animal, and environmental welfare. Key components of a Humane Community include: a multi-system approach to addressing social problems; education and programming that promote and provide access to humane activities to individuals in their everyday lives; and a cultural shift that recognizes the ways in which humane policies serve as a foundation upon which other public health and safety concerns can be addressed more holistically (Hawes, Flynn, Tedeschi, Morris, submitted). To implement and sustain improvements in collective welfare, a Humane Community will have a system of policies promoting collective health that transverse all aspects of public life.

In Humane Communities, collaboration across governmental and nonprofit agencies is critical, so they may work together to identify and implement holistic solutions that address the ways a social problem may manifest in the human, animal, and environmental domains. In this way, animal control policies have a significant impact on the degree to which a Humane Community is achieved. Municipal shelters play a particularly important role in Humane Communities by fulfilling a duty to "protect" the public from any risk that may occur due to increased pet-keeping in communities. These risks include zoonotic disease transmission (e.g. rabies), dog bites, nuisance issues, and improper care or cruelty. In this way, animal control activities serve important animal welfare, human public health, and law enforcement functions (Aronson, 2010). Animal shelters serve as a safety net for people and pets in need in Humane Communities as they serve as a safety net for pets in need by providing temporary housing, affordable veterinary care, accessible behavioral support, relinquishment services to those who can no longer keep their pet, and even end-of-life care.

Risks related to the presence of dogs in a community have historically been mitigated through local animal control ordinances requiring dog licensing, rabies vaccinations, and restrictions placed on animals deemed to be dangerous. Examples of model ordinances include: leash requirements, tethering restrictions, licensing, animal welfare advisory boards, investigation of cruelty/neglect cases, and establishing standards for basic care, including rabies vaccination (Reese and Remmer, 2017). These ordinances preserve the well-being of companion animals in the community while also maintaining the health and safety of the human residents and greater environment. Studies show that animal-related complaints are an ongoing area of concern for municipalities as rates of pet-keeping continue to increase. A survey of mayors in 1974 ranked animal-related issues as the most common complaint in their offices (Clancy and Rowan, 2003). A more recent estimate cites that there are anywhere from 1.5 to 4.5 animal control complaints per 1,000 people in major U.S. cities (Clifton, 2002). Therefore, it is becoming increasingly important that the fields of animal welfare and/or city/county management establish a series of guidelines for what constitutes effective animal control ordinances.

Breed Specific Legislation (BSL) remains a controversial animal control ordinance aimed at reducing the risks associated with dangerous dogs. Despite the prevalence of dangerous dog laws in most U.S. cities, some cities have placed additional restrictions on certain breeds of dogs (most commonly, American Pit Bull Terriers, American Staffordshire Terriers, and/or Staffordshire Bull Terriers). While there are many disagreements regarding the identification of breeds and the genetic basis of behavior that inform the use of this term (further discussion of these issues are included in this report), pit bull type dog (PBTD) will be used throughout this report for conciseness and is intended to include all dog breeds identified for restriction in BSL legislation. Current estimates have identified over 1,000 U.S. cities with some form of restriction placed on pit bull type dogs (PBTDs) (e.g. mandatory sterilization, explicitly identified as "dangerous", banned) (DogBites.org, 2017).

A number of studies have been conducted to date assessing the impact of BSL on a variety of public health metrics including: dog bites (Cornelissen and Hopster, 2009; Creedon and O'Suilleabhain,

2017), adoption from shelters, euthanasia rates (Gunter, Barber, and Wynn, 2016; Clevenger and Kass, 2003), and responsible pet-keeping practices (McCarthy, 2016; Medlin, 2007). This study aims to identify the social and economic impacts of BSL in the City and County of Denver. It is the third in a portfolio of studies conducted by IHAC that assess the impacts of various animal welfare policies on communities (Hawes et al., 2018; Morris et al. 2017).

Methodology

A Social-Environmental-Economic Impact Assessment (SEEIA) provides the opportunity to conduct an interdisciplinary evaluation of the potential impacts of a given policy, event, or organization on a community's well-being. "Well-being" is conceptualized in a holistic manner to include socio-economic, physical, and mental/emotional health of humans, but also includes relationships with animals and the environment as integral components of the health of a community. Consistent with good impact assessment practice, this study was conducted by a multidisciplinary team that included experts in the fields of economics, business, social work, law, and research design. This process of utilizing a multidisciplinary team to integrate research evidence, local data, and the knowledge of stakeholders, particularly members of the affected communities, is congruent with impact assessment industry standards (Mindell, Bolton, Forde, 2008).

In general, linear regression analysis was used to identify simple monotonic increases or decreases in trends in the data over time. Slopes with *p* values less than 0.05 were considered to have slopes significantly different than zero, and the slope is reported as the average change per year. Slopes with *p* values greater than 0.05 but less than 0.10 were reported as approaching significance. Slopes with *p* values greater than 0.10 were considered to represent trends that had not changed significantly over the study period. The most recent value for any given data set is calculated as the y-intercept plus or minus the slope of the linear trend times the number of years until the year of interest.

The City and County of Denver's BSL was enacted in 1989. Standard economic methods were used to estimate the impact of the changes in enforcement practices regarding specific dog breeds in the City and County of Denver over the study period of 1989-2017. This new activity was first measured by calculating the direct costs to Denver Animal Protection (DAP) to implement the legislation. Standard economic models were then used to calculate the economic impact of the new activity on the City and County of Denver and the surrounding communities (i.e. Longmont, CO). Broader effects, including the community's reaction to BSL, were estimated using surveys and publicly available data sources. Data were analyzed using multiple methodologies, including time series event analysis (e.g., before/after analyses), and cross-sectional comparisons to evaluate the impact of the new animal control activity.

To estimate the broader, but less quantifiable, social and environmental impacts of the City and County of Denver's BSL, data from other stakeholders in the policy, such as public health agencies, community members, and those agencies more indirectly involved in operationalizing the policy, were considered. Denver Animal Protection (DAP) provided access to all data regarding shelter operations at Denver Animal Shelter (DAS) (e.g. intake source and outcome of PBTDs in their care), dog licensing, and bite rates in the City and County of Denver from the years 2007 to 2017. Data were not available from DAS on these variables prior to 2007 due to changes in shelter data software. DAP provided access to all budget data regarding staff who were involved in enforcing BSL for the years 1989 to 2017. Data on dog attacks and dog bites in the City and County of Denver were obtained for the years 1989 to 2006 through public information requests submitted by journalist, Jared Maher for his 2009 *Westword* articles[1,2] (Maher, 2009). Longmont Humane Society provided access to data regarding animals they had transferred into their care from DAS from 2008 to 2017.

[1] *Westword* is a weekly newspaper published in Denver that covers current events in the community.

[2] Since these data were obtained prior to the use of the current data collection system, DAP could not verify these data.

Overall, this study assessed both the narrow and broad economic, environmental, and social impacts of the event under investigation, creating a comprehensive model of the effects of this animal welfare policy in the Denver community. A detailed description of specific analyses are included throughout the body of this report.

Background

Legislative History

Nationally, there are jurisdictions in 35 U.S. states that have enacted some form of BSL. However, 15 states, including Colorado, have adopted pre-emption laws that prohibit enacting such types of legislation. Of the 271 cities in Colorado, just 5 have active breed-specific legislation. Those cities are: Aurora, Commerce City, Denver, Lone Tree, and Louisville. In June of 2018, the city of Castle Rock, CO repealed its breed ban policy that had been in effect since 1992, in favor of a two-tiered system for enforcing dangerous dog policy (Appendix A). Fort Lupton, CO repealed their BSL in February 2019, effective March 2019.

The City and County of Denver's BSL was enacted by Mayor Federico Peña on July 31, 1989 following a series of reports on severe dog bites by pit-bull type dogs (PBTDs) (Macang Maher, 2009). Under the City and County of Denver's Animal Control Ordinance Section 8-55 (also referred to as the "pit bull ban"), PBTDs are banned in the City and County of Denver. In this ordinance, PBTDs are defined as any dog displaying the majority of the distinguishing (physical) characteristics that conform to the standards established by American Kennel Club or United Kennel Club for the following breeds: American Pit Bull Terrier, American Staffordshire Terrier, or Staffordshire Bull Terrier (Denver Animal Protection, 2017a; Denver Animal Protection, 2017b). American Bulldog, Wolf Hybrid, Presa Canario, Bull Terrier, Cane Corso, and Rottweiler dogs are not included in the list of restricted breeds for the City and County of Denver.

The BSL has persisted with controversy during the 30 years it has been in place in Denver. Following the initial implementation of the ban, a group of animal welfare organizations filed suit against the City and County of Denver, which led to the 1992 Colorado Supreme Court ruling that upheld that the city had a rational basis for outlawing PBTDs. In 2003, the Colorado State Assembly passed legislation to strengthen the state's dangerous dog laws with an additional provision that would prevent local governments from having breed-specific regulations. The City and County of Denver filed suit to protect its rights to continue enforcing its breed-specific legislation, with the city council stating that the Colorado constitution protects the ability of a home-rule municipality to create and maintain its own laws. Although a Denver District Court judge agreed with the City and County of Denver on the home-rule issue, he allowed the Colorado Attorney General's Office to pursue its argument that, in the fourteen years since the original decision, new research on dog bites and attacks could be presented as proof that PBTD bans are irrational. In these proceedings, the City and County of Denver argued that the ban was justified not necessarily because evidence showed that PBTDs bite more frequently, but because the history and physiological traits of the breeds that are categorized as PBTDs make PBTDs more likely to cause severe injury and death if they do bite. During the period of April 2004 to May 2005 the ban was temporarily inactive while this litigation was underway. In April 2005, the judge ruled that the state had failed to prove that the City and County of Denver had no rational basis for prohibiting PBTDs, and the ban remains in effect to this day. Therefore, the City and County of Denver, Colorado's breed ban is unique in that it has been constitutionally upheld on two separate occasions and is consequently considered to be a "model ordinance" for breed ban-type policies.

Social History

BSL has been implemented throughout the U.S. as a means of promoting public safety by decreasing the presence of dangerous dogs in communities. However, Molloy (2011) discusses how by proposing a definition of which companion animals make suitable pets for "responsible" pet owner "the processes that led to this legislative intervention raised questions about the role of dogs in contemporary urban environments and the social identities of 'dangerous dog' owners." In the late twentieth century, as the U.S. population increased over time due to immigration, pit bulls became increasingly employed as an affordable means of receiving protection and companionship for people in inner cities (Rivero, 2016). The introduction of BSL marked a transition in how policy makers would act upon the social stigma of certain breeds of dogs and the individuals that keep them to regulate the presence of specific dogs in communities.

Historically, the breeds of dogs associated with individuals of lower socioeconomic status (i.e., American Bulldog, Wolf Hybrid, Presa Canario, Bull Terrier, Cane Corso, Pit Bull, and Rottweiler) have been subjected to discriminatory legislation due to a higher perceived risk for public safety issues such as disease and violence than the pets kept by individuals in more affluent areas (McCarthy, 2016). Over the course of history, the dogs labeled as dangerous and subjected to the highest penalties are also linked to people with the least political power, typically black and brown individuals (Dickey, 2016; Brown & Atske, 2016). This discrepancy in political power for black and brown individuals and families has made them more vulnerable to issues like overpolicing by human and animal law enforcement.

Arluke (2003) describes the ways in which PBTDs became a mechanism through which human and animal law enforcement integrated racial profiling into their patrol of communities. In the 1990s, the co-occurence of animal cruelty related offenses and criminal activity, such as drug use on the sites of dog fights, resulted in partnerships between local police and humane law enforcement. These enforcement efforts then led to regular sweeps of neighborhoods to spot "suspicious" dog owners who may be utilizing their pit bull type dogs for illicit activities. Finally, an increase in media coverage of dog attacks by PBTDs ultimately resulted in significant fear of PBTDs throughout U.S. communities (Twining, Patronek, & Arluke, 2000; Marchello, 2017). Both media portrayals of severe dog bites by PBTDs and the research literature on the risks of ownership of "high-risk dogs" has led to a controversial discussion in policy-making around which types of dogs communities should be permitted to keep and therefore led to policies such as BSL.

The Impacts of the City and County of Denver's BSL

While it is important for policy-makers to acknowledge how social attitudes have informed our current understanding of PBTDs and of the individuals that keep them, it is equally important to ensure that the policies, such as BSL, enacted based on these social attitudes are also evaluated objectively for their impacts on other components of community health. As Molloy (2011) articulates: "canine-human interactions are not without material risks, and there is no question that dog bites and fatalities resulting from companion dog attacks do occur. What is of concern here, however, are the outcomes of the processes by which such incidents are selected, mediated, and constructed as 'risks.'" In the interest of advancing the discussion on the strengths and limitations of BSL policy, this report will evaluate the impacts of BSL on animal welfare, community health, and the economic and legal systems of the City and County of Denver.

Impacts on Animal Welfare

Overview of Denver Animal Protection and Denver Animal Shelter

DAP is the enforcement agency for animal control and protection ordinances in the City and County of Denver. In addition to being the primary agency enforcing the City and County of Denver's BSL, DAP also manages the DAS (Denver Animal Shelter) facility. The new DAS shelter facility opened in

June 2011 and was designed to reflect Denver's commitment to both animal welfare and sustainability. The construction of the $17-million facility was funded by the citizens of Denver through the Better Denver Bond Program and offers amenities including cat colonies, animal visitation rooms, and local artwork. In May 2012, DAS was awarded the Platinum Leadership in Energy and Environmental Design (LEED) designation, which certifies that the building meets the green standards for an energy- and environmentally-efficient structure. DAS handles a significant portion of stray and otherwise unhoused companion animals in the City and County of Denver, taking in approximately 4,500 dogs in 2017.

General Guidelines Under the City and County of Denver's Section 8-55 Ordinance ("the Pit Bull Ban")

The City and County of Denver's BSL ordinance, Section 8-55, is enforced in two primary ways: through animal protection officer activities and through the intake and adoption policies of the DAS municipal sheltering facility (Appendix B). These enforcement processes were added as additional responsibilities for DAP when the ordinance was passed in 1989. Ongoing efforts have been made to evaluate the effectiveness of these procedures and adjustments have been made over time to ensure the policy is adequately enforced. These adjustments include the number of officers out in the field and the personnel involved in the breed identification process (Denver Animal Protection, 2012).

Under Section 8-55, all dogs suspected to be one of the restricted breeds that are found within Denver's city limits are subject to evaluation by DAP. The cost of this evaluation has remained at $25. In most cases, owners are also expected to pay the cost of boarding their dog over the evaluation period, which may take anywhere from 1-5 days, depending on staff capacity. The owner of a suspected restricted breed can comply with this ordinance voluntarily by presenting the dog at DAS for an evaluation, or an animal protection officer may encounter a suspected restricted breed in the field and confiscate it for transport to the municipal shelter under a "Section 8-55 Hold." The animal may be confiscated if the officer has reason to believe the dog's owner will not comply voluntarily with the evaluation, if the dog is in violation of another City and County of Denver ordinance (i.e. abandonment, barking/nuisance, dangerous dog, spay-neuter), or if the officer has previously requested that the dog be brought in for a voluntary evaluation and the owner did not comply.

A dog presented for evaluation at the DAS facility will receive a breed evaluation by DAP staff. While all stray dogs that are suspected to be restricted breeds will also receive a behavior evaluation[3,4], owned dogs will not. The breed determination at DAP is completed by three independent evaluators and is based on the criteria outlined in the ordinance: any dog displaying the majority of physical traits of any one of the American Pit Bull Terrier, American Staffordshire Terrier, or Staffordshire Bull Terrier breed, or any dog which substantially conforms to the standards established by American Kennel Club or United Kennel Club. The three evaluators complete their assessment independently to reduce potential bias. DAP's policy (as of 2005) requires that there is consensus among the three independent evaluators[5]. If any one of the three evaluators determine that the dog is not primarily one of the three restricted breeds, then the dog cannot be held under Section 8-55.

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[3] Denver Animal Shelter uses the Pueblo Canine Assessment Tool (PCAT), developed by the Associate Certified Applied Animal Behaviorist, Jennifer Barg, for its behavior assessment. During this assessment, the dog goes through a series of handling exercises, including a test for any food, rawhide (considered a food item), or toy/ball guarding behaviors. All dogs who are over 40 lbs., dogs who have shown any concerning behavior towards other dogs while in the shelter, or who have a history of not behaving well with other dogs are then observed in multiple dog to dog interactions as a component of their assessment. Efforts are made to observe these dog to dog interactions with at least one other male and one other female dog. Finally, a comprehensive assessment is completed that takes into account the results of the PCAT behavior assessment, the dog to dog interactions, the dog's general behavior in the field, the dog's behavior during its general intake and processing at the shelter, the dog's behavior during their veterinary physical examination, the dog's behavior when being handled by staff and volunteers at DAS, and finally, any history provided by the previous owner (when applicable).

[4] This evaluation process is also used for any dog involved in a bite or attack.

[5] This policy was revised in 2005 following a lawsuit.

DAS uses a visual assessment to determine banned breeds under BSL. However, existing research indicates that there may be limitations to the visual evaluation processes used by animal shelters to assess the breed and behavior of unhoused dogs in their care. One study showed a high degree of disagreement in shelter workers on the breed of an animal following a visual breed assessment (Hoffman, et al., 2014). Another study found that shelter staff and veterinarians using physical traits to determine breed were incorrect over 75% of the time when comparing their identification to the dog's genetic structure (Voith et al, 2009).

Most studies suggest that DNA testing is a more accurate predictor of breed than physical evaluations (Barnett, 2011; Boyko, et al., 2010; Voith, et al., 2013; Gunter, Barber, & Wynne, 2018). However, there are limitations to DNA testing, particularly with mixed breed dogs. Parker et al. (2004) found genetic variance even among dogs within the same American Kennel Club (AKC)-certified breed. In a study of DNA testing results of shelter dogs, Gunter, Barber, and Wynne (2018) found that as the number of pit bull-type relatives in a dog's heritage increased, so did the shelter's ability to match the results of DNA analysis through visual identification. Ultimately, Gunter, Barber, and Wynne (2018) concluded that due to the variability in how genetics might manifest for an individual dog, focusing resources on communicating the physical and behavioral characteristics of shelter dogs is likely the most effective approach to support responsible adoption efforts. While some cities with BSL utilize DNA testing, DAP does not use this practice in its evaluations of suspected restricted breed dogs (Barnett, 2011; Marchello, 2017).

If a dog is determined not to be a restricted breed through DAP's visual breed identification process, the 8-55 citation is voided, the evaluation fees are typically waived, and the dog is returned to their owner with a letter certifying that the dog is a legal breed that can reside in the City and County of Denver. The owners of the dogs that are certified as a restricted breed are issued an "8-55 Enforcement Letter" in which they are notified that the dog must be removed from the Denver city limits and that if found in the City or County of Denver again, the dog will be impounded. Owners then sign this letter certifying that they will take immediate actions to relocate the dog. Impounded dogs under 8-55 may either be transferred to another shelter outside of Denver or euthanized (see Impacts of Denver Animal Shelter's Dog Outcomes section). All evaluation results are logged in DAP's records so that dogs are not inadvertently evaluated multiple times. Animal protection officers will periodically follow up with owners of a cited dog, when necessary, to ensure alternative accommodations for the dog have been secured.

Impacts on Denver Animal Shelter's Dog Intake

In order to assess the impact of the City and County of Denver's BSL on Denver Animal Shelter's rates of intake, data was first analyzed on the rates of intake of all dogs in the care of Denver Animal Shelter. An analysis of the trends in DAS' total intake informs the discussion of the impacts of the breed ban insofar as it provides evidence for how removing certain breeds of dogs from the community is impacting the municipal shelter's capacity to serve other people and pets in need in the community. As a municipal facility, DAS' primary sources of intake are stray animals, animals surrendered by their owners, and animals obtained through confiscation (Figure 1). The upward trend in total intake between 2007 to 2017 (the period for which data was available through DAS) was approaching significance, with an average increase of 80 dogs per year ($p=0.06$) to a total of 4,509 dogs in 2017. However, when the growth in human population in Denver is accounted for there was no significant trend ($p=0.72$), with total intake of an average of 6.8 dogs per 1,000 residents per year. These trends contrast with an overall decrease in dogs taken into animal shelter and rescue organizations across the entire state measured during a similar period (2007 to 2015) (Hawes, et al, 2019).

The rate of owner surrender at DAS decreased significantly at an average rate of 56 dogs per year ($p < 0.01$) to 456 dogs surrendered in 2017. A decreasing trend of 0.11 dogs per year ($p < 0.01$) was

also seen when the growth in human population was accounted for. In 2017, 0.52 dogs per 1,000 residents were surrendered to DAS by their owners. The trend in the number of stray dogs taken into the shelter has increased significantly at an average rate of 126 dogs per year ($p < 0.01$) to 3,476 dogs in 2017. This increasing trend is also significant on a per capita basis, with an increase from 4.4 stray dogs to 5.7 stray dogs per 1,000 residents in 2017 ($p=0.05$). The trend in the number of dogs transferred into the care of DAS from other facilities was approaching significance ($p = 0.09$), increasing by an average of 9 dogs per year to 77 dogs in 2017. However, there was no significant trend ($p=0.67$) on a per capita basis at an average of 1.3 dogs transferred in per 1,000 residents each year. The trend in the number of dogs that entered into DAS' care as returned adoptions increased by an average of 9 dogs per year ($p < 0.05$) to 87 dogs in 2017. There was also an increasing trend on a per 1,000 capita basis from 0.02 dogs in 2007 to 0.10 dogs in 2017. The declining trend in the number of dogs confiscated approached statistical significance ($p = 0.08$), with a decrease by an average of 9 dogs per year to 413 dogs in 2017. A statistically significant ($p=0.02$) decreasing trend was found when the growth in human population is accounted for at -0.02 dogs per year to 0.58 dogs per 1,000 residents in 2017.

Rates of shelter intake are indicators of community-wide animal welfare needs. As the community's animal welfare safety net, the municipal shelter's intake rates will reflect a community's capacity to care for the companion animals they keep. DAS' pet retention programs, such as the Hope program, offer financial assistance to address medical or behavioral challenges. These pet retention programs appear to have influenced the observed decrease in rates of intake by owner surrender. DAS' partnership with the Dumb Friends League in Denver, CO through the Denver Stray project may have influenced the rates for both stray intake and intake via transfer. To decrease the number of shelter locations a Denver resident needs to contact to find a lost pet, the Denver Stray project encourages the Dumb Friends League to refer all stray dogs to Denver Animal Shelter, which likely influenced the observe increase in stray intake at DAS. Increases in the returned adoptions may be related to the introduction of an adoption consultation process that works one-on-one with adopters who wish to care for the dogs with more challenging behavior. These dogs may be returned several times before identifying the best home for them.

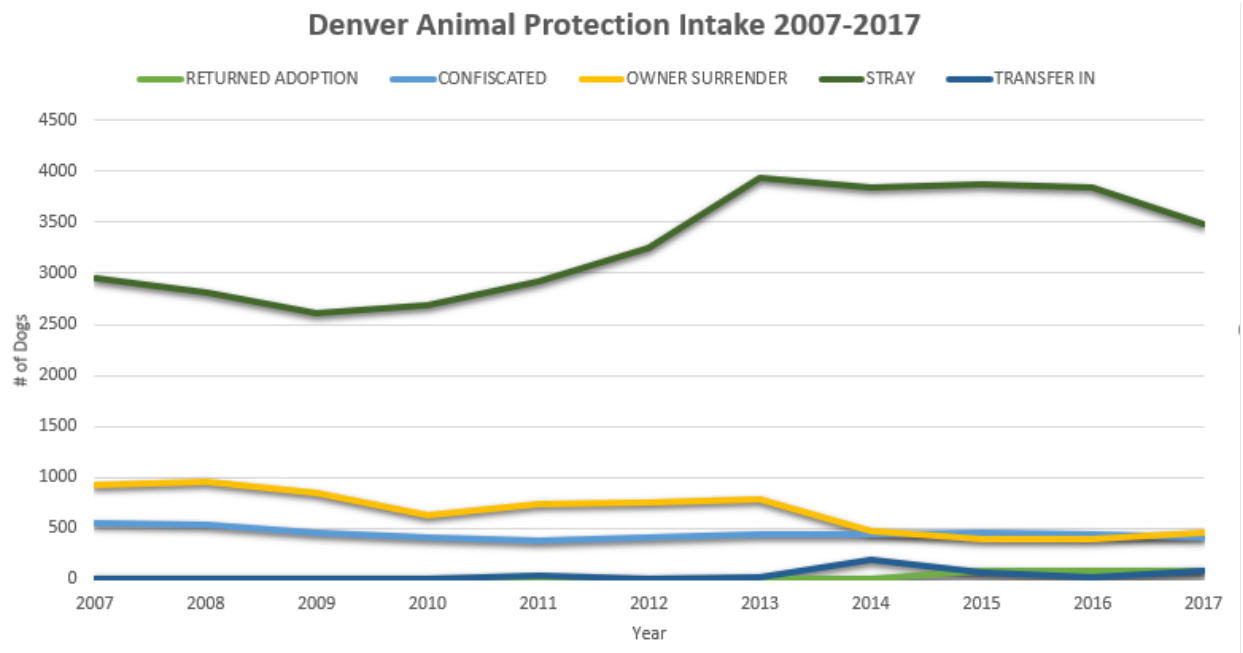

Figure 1. Trends in intake for all dogs at DAP from 2007 to 2017.

In more recent years, the breed ban has been enforced within this context of decreasing rates of owner surrender and increasing rates of stray and returned adoptions. Restricted breeds that are subject to the 8-55 ordinance come into the shelter's care primarily as strays or as confiscations but can also be admitted as a result of owner surrender. Overall, the rate of intake due to 8-55 citations appears to have decreased from 2007 to 2017, which would indicate that either there are fewer PBTDs in Denver or that DAS has seen a decrease in breed ban related enforcement actions (Figure 2). However, the linear trend through these data is not statistically significant due to fluctuations in the rates of restricted breed intake from 2007 to 2017 ($p = 0.80$). When the growth in human population in Denver was accounted for, there was a statistically significant decreasing trend ($p=0.01$) of -0.03 dogs per year to 0.12 dogs per 1,000 residents at the end of the study period, which indicate that human population growth in Denver may impact the number of restricted breeds brought into DAS. In 2017, there were 41 dogs in the care of DAS under the 8-55 ordinance. Twenty-five of these dogs were taken in as confiscations and 16 dogs were taken in as strays. No dogs surrendered by owners to DAS in 2017 were held under the Section 8-55 ordinance. DAP largely attributes this decrease in number of dogs held under 8-55 to a decrease in the number of PBTDs in the City and County of Denver and an increased utilization of the voluntary evaluation process. This decreasing number of 8-55 holds may also indicate that the need for BSL is diminishing.

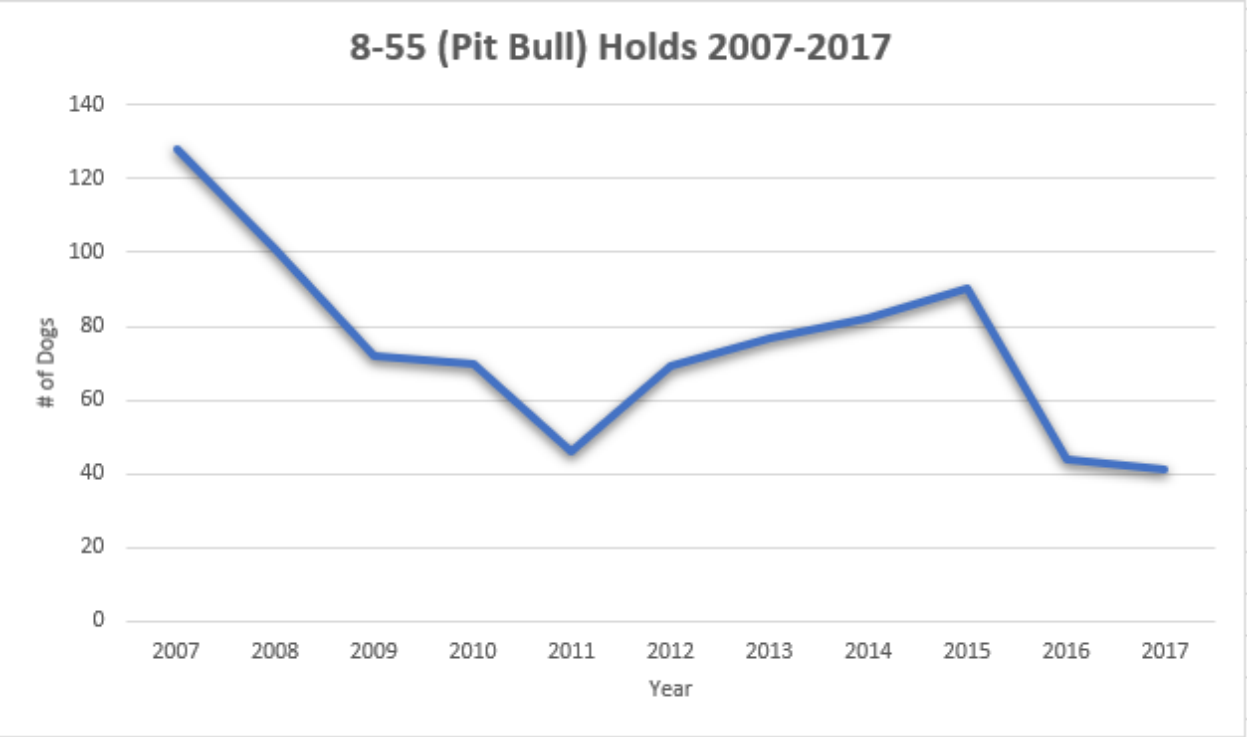

Figure 2. Number of dogs brought into the care of DAS through an 8-55 Hold from 2007 to 2017.

While the overall number of PBTDs held by DAS are decreasing, from 2007 to 2017, dogs that were identified as restricted breeds, consistently experienced a longer length of stay at DAS (Figure 3)[6].

[6] Length of stay was calculated by taking the date of outcome minus the date of intake for each dog. An average of breed group's length of stay was then calculated using all of the dogs in each breed group who were in the care of DAS that year.

The average length of stay for all dogs in the care of the shelter from 2007 to 2017 was 8.4 days, while the average length of stay for restricted breeds was 61% longer at 13.8 days over the same period.

There is limited scientific literature on the relationship between increased lengths of stay in shelters and the quality of life for a dog. To date, there is no standardized definition in animal welfare for what specifically constitutes quality of life. Some studies have documented the stress and health risk that result from increases in length of stay at shelters (Hennessy, et al., 1997; Protopopova, 2016). Advancements in veterinary medicine to address chronic disease and illness now equip shelters with the ability to extend the lifespan of shelter animals through medical and behavioral support programs (Hawes, Kerrigan, and Morris, 2018; Rollin, 2007). However, what constitutes an appropriate length of stay within a sheltering system remains a highly debated topic in the field of animal welfare and requires more in-depth research. More data is needed to evaluate how the increased average length of stay has impacted the quality of life for PBTDs in the care of DAS.

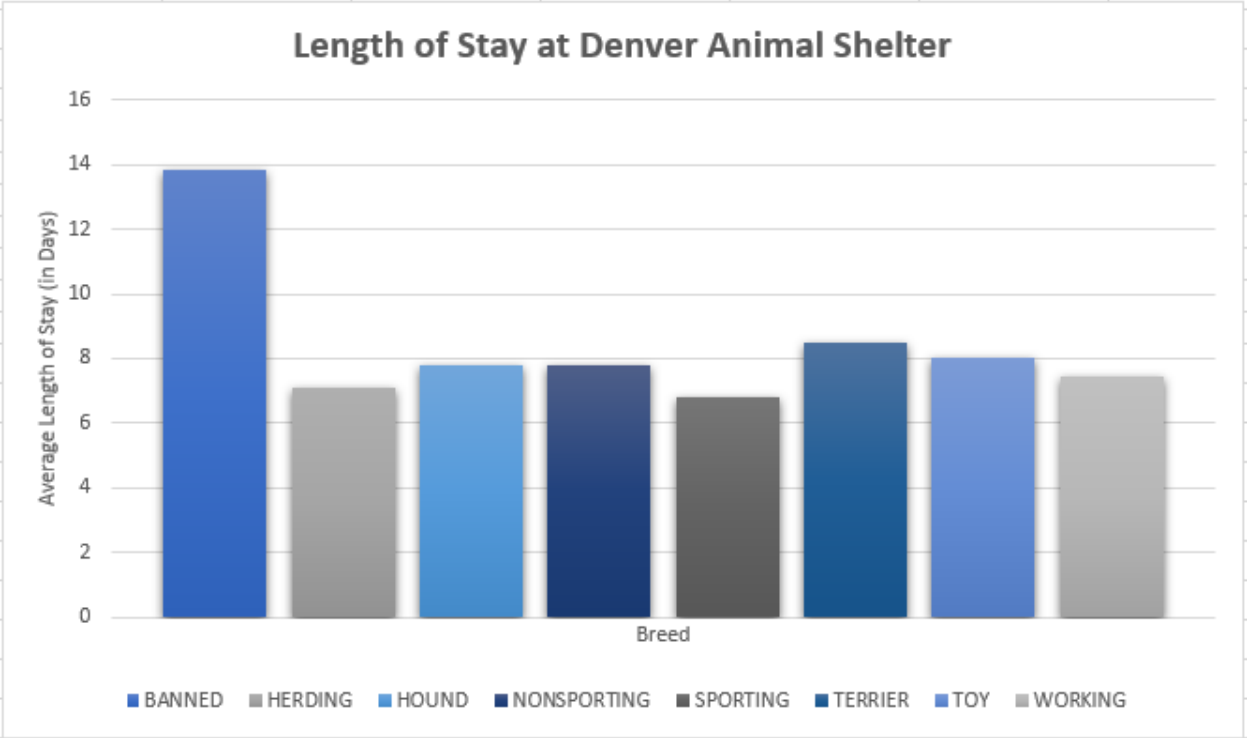

Figure 3. Average length of stay (in days) for all breeds of dogs in the care of DAS from 2007 to 2017.

Impacts on Denver Animal Shelter's Dog Outcomes

Most breeds of dogs leave the care of DAS having been either adopted or returned to their owner (Figure 4). Over the study period, the trend in all dog adoptions was not statistically significant ($p = 0.23$), remaining constant at an average of 1,203 dogs per year. The trend in all dog adoptions on a per capita basis was also unchanged ($p = 0.92$) at 1.87 dogs adopted per 1,000 residents. The trend in the number of dogs returned to their owners has increased at an average rate of 89 dogs per year ($p < 0.01$) to 2,125 dogs in 2017. The trend was also increasing ($p < 0.01$) on a per capita basis at 0.10 dogs per year to 2.2 dogs per 1,000 residents in 2017. The trend in the number of dogs transferred out to other facilities was not statistically significant ($p = 0.61$) at a constant rate of 733 dogs per year. The trend was also unchanged ($p = 0.67$) at 1.31 dogs per year per 1,000 residents throughout the study period. The declining trend in dogs euthanized was approaching significance ($p = 0.07$), with an average decrease of 50 dogs per year to 681 dogs in 2017. However, there was no statistically significant trend ($p=0.12$)

when the growth in human population was accounted for at an average of 1.47 dogs per year per 1,000 residents. The trend in number of dogs that die in care was not statistically significant ($p = 0.17$) at a constant rate of 14 dogs per year. The trend is also not statistically significant ($p = 0.27$) when growth in human population is accounted for at 0.03 dogs per year per 1,000 residents.

These steady and increasing rates of positive outcomes (adoptions and returned to owner) and decreasing rate of negative outcomes (euthanasia) indicate that DAS is contributing positively to the lives of the animals that enter the shelter's care.

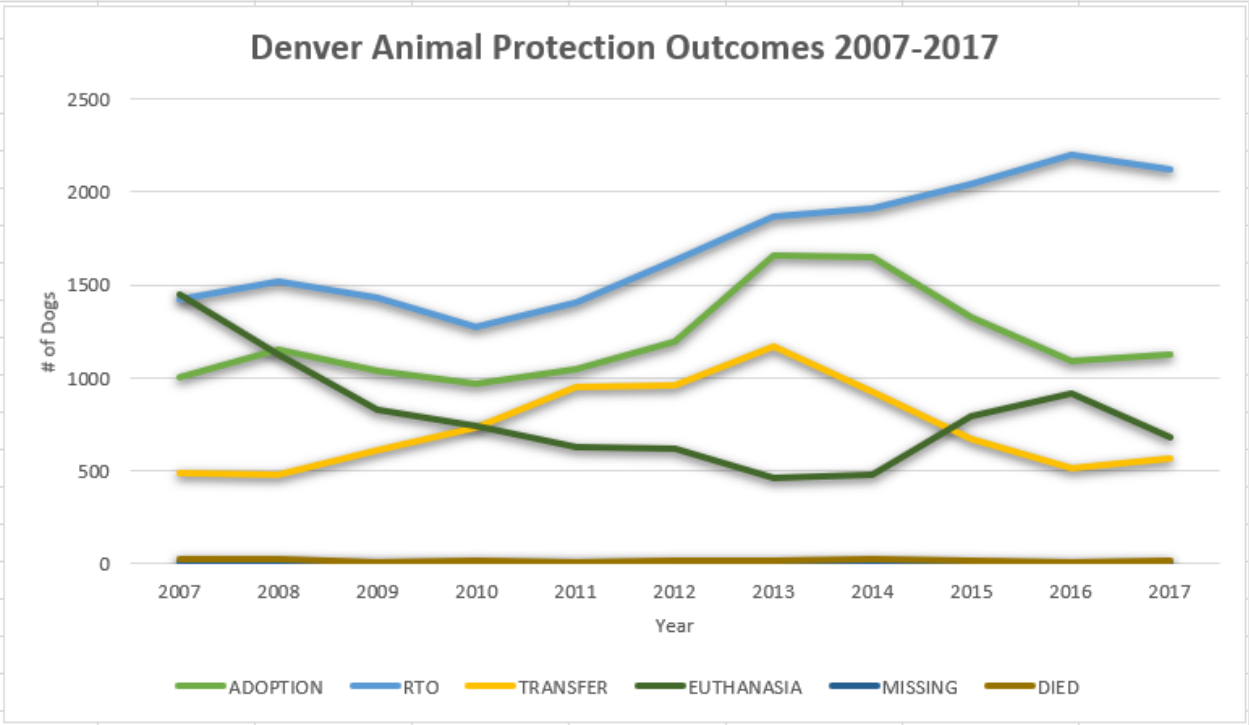

Figure 4. Trends in outcomes for all dogs at DAS from 2007 to 2017.

The trends in outcomes for dogs of restricted breeds under BSL differ from those seen in the greater population of dogs in DAS' care. Under the ordinance, no PBTD can be adopted out to residents of Denver, however these dogs could be returned to their owner, transferred to other shelters or rescues outside of Denver, or euthanized (Figure 5). Of the 41 dogs held under Section 8-55 in 2017, 1 dog was adopted[7], 19 were returned to their owner, 2 were transferred, and 19 were euthanized. Beyond the 41 dogs that entered the care of DAS under an 8-55 Hold in 2017, there were additional PBTDs that came to DAS through sources other than 8-55 holds. Of these dogs, 44 were returned to owner, 33 were transferred, 48 were euthanized, and 1 died in the care of DAS.

Because the City and County of Denver's breed ban does not permit dogs of restricted breeds to be adopted, there were no data over the 2007-2017 study period on the number of restricted breed dogs adopted out of the shelter to be analyzed. According to the scientific literature, PBTDs are less likely to be adopted and more likely to be euthanized in a shelter, even in communities without BSL (Clevenger and Kass, 2003; Gunter, Barber, & Wynne, 2018; Lepper, Kass, and Hart, 2002; Lord, et al., 2006).

[7] After further examination, it appears this dog was ultimately determined to be an American Bulldog and not a restricted breed, therefore they were eligible to be placed up for adoption.

According to Denver's BSL ordinance, dogs that have been certified as a restricted breed can be microchipped and then returned to owners on their first offense on the condition that the ownership of the dog is transferred to a residence outside of Denver, or if the owner can verify that they reside outside of the city limits. Any dog of a restricted breed that is encountered within the City and County of Denver a second time can no longer be returned to owner regardless of if the owner intends to relocate the animal or if the owner resides outside of Denver. Over the study period, the declining trend in number of dogs of a restricted breed that were returned to owner was approaching significance ($p = 0.06$) with an average decrease by 4 dogs per year to 63 dogs in 2017. This was also true on a per capita basis ($p = 0.09$), with a decrease of 0.01 dogs per year to 0.11 dogs per 1,000 residents in 2017. These decreasing trends in return of these dogs to their owners, while the trend increases for all other breeds in DAS' care, can be attributed directly to BSL. The trend in RTO for restricted breeds demonstrates the ways in which BSL in Denver continues to regulate the types of dogs "responsible" pet owners can keep.

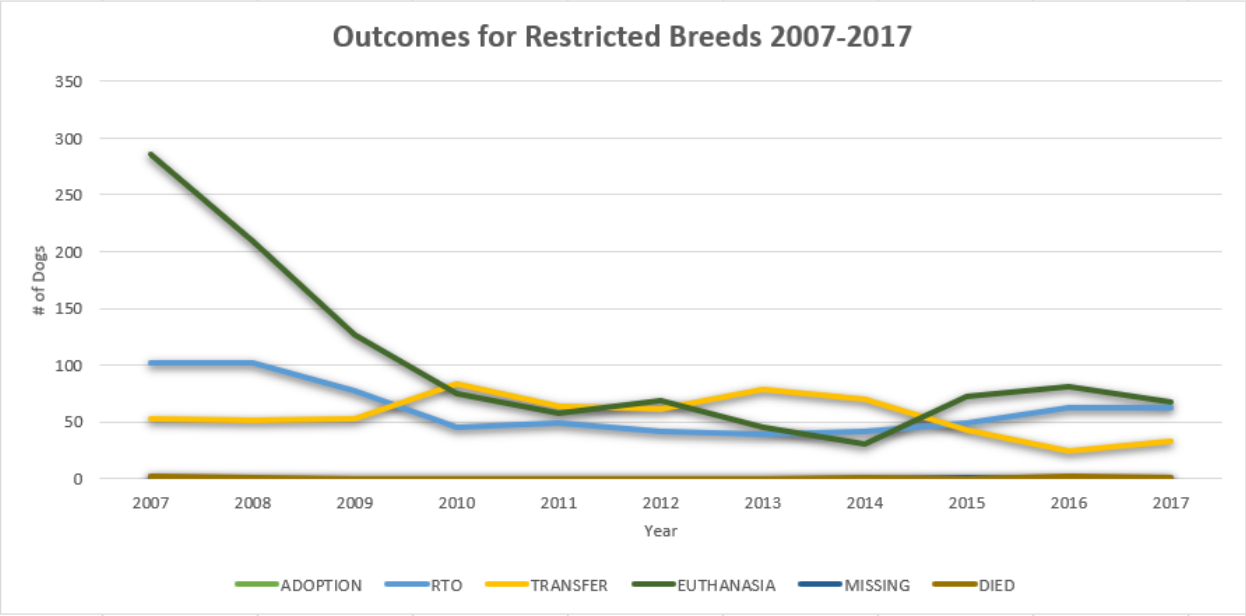

Figure 5. Trends in outcomes for dogs of a restricted breed at DAS from 2007 to 2017.

Similar to that for all dogs at DAS, the trend in the number of dogs of restricted breeds that were transferred has not changed significantly ($p = 0.21$) over the study period remaining constant at 55 dogs per year. However, on a per capita basis there was a decreasing trend approaching statistical significance ($p = 0.07$) at 0.01 dogs per year to 0.11 dogs per 1,000 residents in 2017. DAS utilizes transfers to optimize the flow of animals through the shelter, to give a dog access to specialized resources like medical or behavioral care that DAS may not be able to offer, and to increase the likelihood that a dog will be adopted. DAS primarily transfers animals to other shelters and rescues in Denver and Boulder Counties (Figure 6). The dogs transferred to other shelters and rescues within Denver County do not include PBTDs.

While there were no statistically significant trends in the number of dogs transferred in or transferred out of DAS, transfer partnerships and community partnering are emerging as effective approaches to increasing live outcomes for all at-risk animals in shelters, particularly when an individual organization's resources are limited (Reese and Ye, 2017; Weiss, et al., 2013). Throughout the state of Colorado, animal shelter rescues and organizations have experienced a 77.1% increase in the number of dogs transferred to other organizations within the state from 2000 to 2015 (Hawes, et al., 2019).

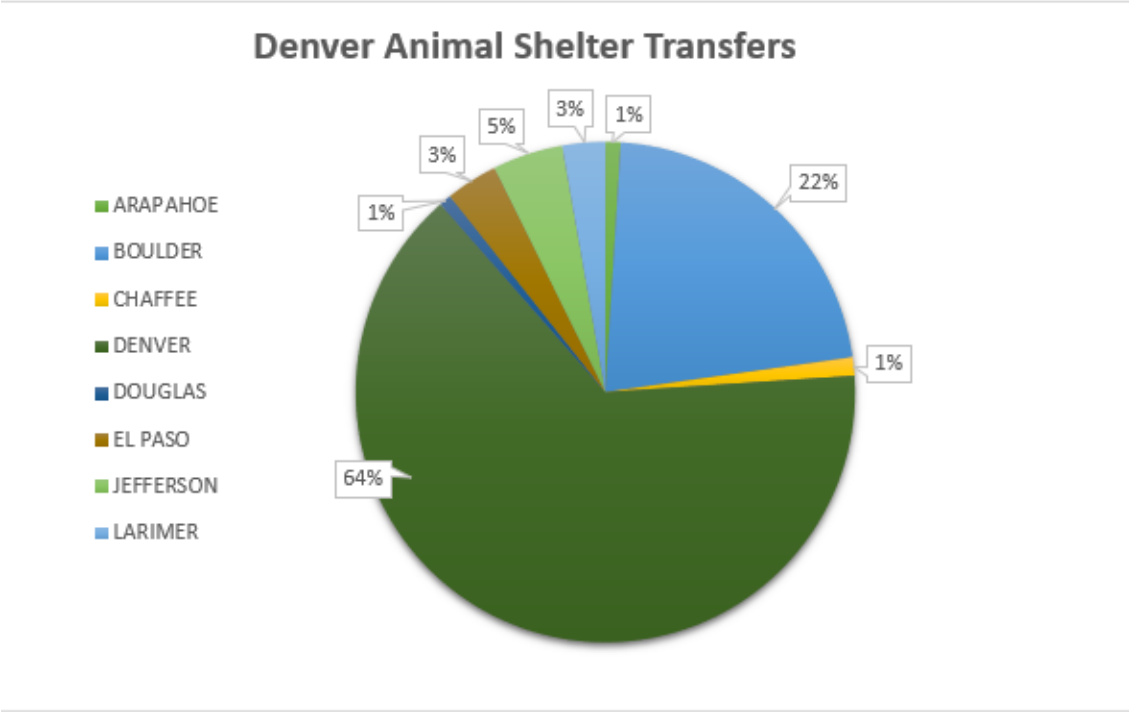

Figure 6. Counties where DAS's transfer partners are located, with percentages of total dogs transferred to each.

Finally, any dogs that are not adoption candidates or eligible for transfer to another facility are humanely euthanized[8]. The trend in the number of dogs of a restricted breed euthanized at DAS has decreased by an average of 17 dogs per year ($p = 0.01$) to 67 dogs in 2017. There was also a decreasing trend on a per capita basis ($p = 0.03$) of 0.02 dogs per year to 0.04 dogs per 1,000 residents in 2017. While the number of dogs euthanized in Denver under the BSL has decreased since its enactment, the euthanasia of any dogs based purely on their physically identifiable breed remains at the heart of the controversy surrounding the legislation. This trend indicates that DAP's proactive efforts to identify and relocate PBTDs in the Denver community has successfully decreased the number of PBTDs euthanized as a result of the City and County of Denver's BSL. However, it is difficult to assess whether or not these PBTDs would have been euthanized if BSL were not present in Denver.

Overall, the trend in the Live Release Rate (ASPCA, 2013) for all dogs in the care of DAS has increased by 1.5% each year ($p = 0.02$) to 84.6% in 2017. For restricted breeds the trend in the Live Release Rate at DAS appears to be increasing, however this trend is not statistically significant ($p = 0.12$) remaining constant at an average of 57.1% (Figure 7).

[8] The cost of the euthanasia procedure, including syringes, drugs, and cremation, is approximately $19.43 (for a 55 pound dog).

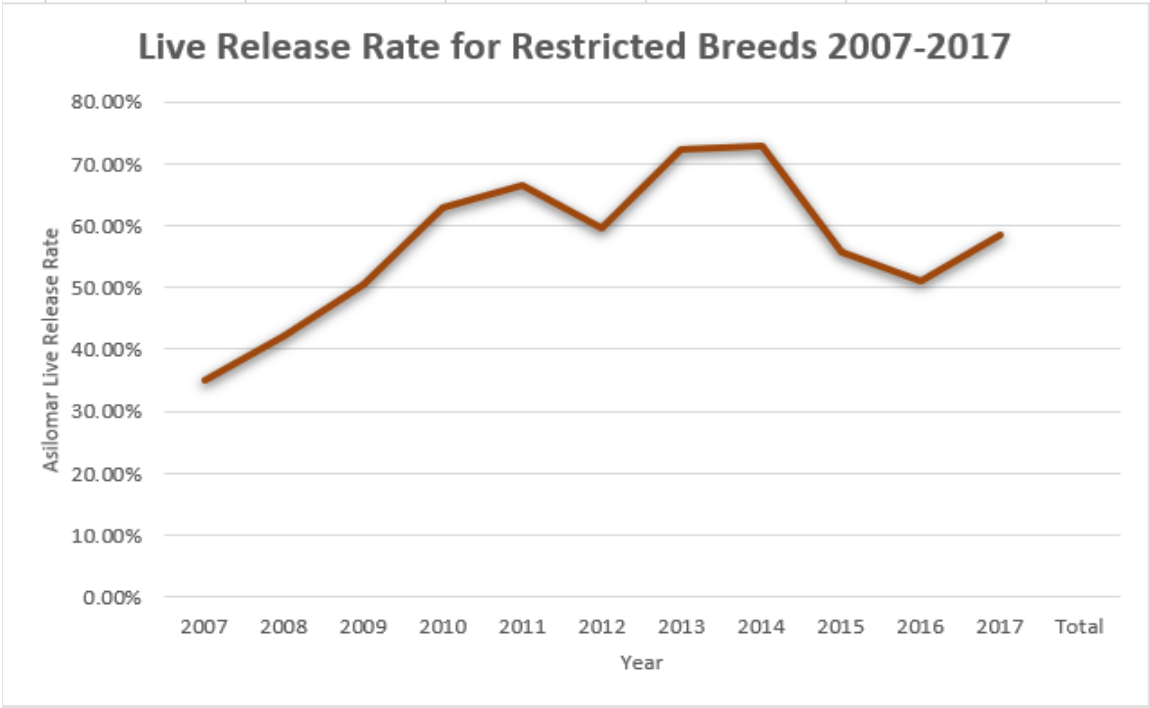

Figure 7. Trends in DAS' Live Release Rate for restricted breed dogs from 2007 to 2017.

Denver Animal Shelter's Behavior Evaluation Process

DAP's behavior evaluation process is intended to gather the information needed to maintain the standard that all dogs that are placed back into the Denver community or into the surrounding communities through adoptions, returns to owners, and/or transfers (regardless of breed) are safe. Underlying the justification for BSL are concerns regarding the association of aggressive behavior with PBTDs. The behavior evaluation process at DAS is often used to determine whether a PBTD will be transferred to another shelter in surrounding communities, or if the dog will be euthanized, however there are a number of limitations to behavior evaluations conducted in shelters.

There are many different types of tests and evaluations that are used to predict or evaluate aggression among dogs in the U.S., and a number of researchers have studied the reliability and accuracy of behavior evaluations for shelter dogs. The American Temperament Test Society (ATTS), for example, promotes uniform temperament evaluation of all dogs[9] (AATS.org, 2018). The average pass rate of all breeds on the ATTS test in 2017 was 83.7%. Out of 913 "pit bulls" that were tested in 2017, 814 passed, or 87.4%. Compared to other dogs that were tested in 2017 with similar numbers, dogs identified as "pit bulls" outperformed many common breeds that are not affected by breed bans; some examples are the Australian Shepard at 82.2%, the Akita at 77.8%, Bouvier Des Flanders at 85.4%, the Collie at 80.8%, Golden Retrievers at 85.6%, and Shetland Sheepdogs at 68.9%.

Patronek and Bradley (2016) discuss real concerns regarding the use of behavior evaluations as diagnostic tools in shelters despite their lack of scientific validation. The literature indicates that the breed of a dog is less indicative of whether they will pass a shelter behavior exam than other factors, such as owner behavior, socialization of the dog, and spay-neuter status (Bollen and Horowitz, 2008; Ott, et al., 2008; Svatberg, 2006). Bennett et al. (2015) found behavior evaluation results differed greatly

[9] In the twelve minutes the test takes to complete, the dog is on a six-foot leash with three ATTS trained evaluators that score the dog. Failure of the test occurs when the dog shows panic or strong avoidance without recovery or unprovoked aggression. While temperament of a dog is usually a good indicator of whether or not a dog is going to lash out, it is not the only factor and it is important to note that the ATTS test only tests for temperament and under no circumstance suggests that is the only reason a dog will bite.

after three days at a shelter likely due to acclimation to the stressors of the shelter. Another study found that dogs who displayed food possessiveness or aggression in the shelter who were then adopted had a 50% (or less) chance of displaying resource guarding in the home (Mohan-Gibbons, Weiss, & Slater, 2012; Marder, et al., 2013). Medlin (2007) found that the behavior and actions of owners are more accurate predictors of dog behavior than a breed label. Furthermore, Diesel, Brodbelt, and Pfeiffer (2008) found that not only is there a high level of disagreement between two different behaviorists scoring the same dog in a behavior evaluation, but that two months following an evaluation, the behaviorists would then often disagree with their own previous score. The findings of these studies indicate that behavior tests in shelters should not be considered reliable predictors of a dog's behavior in a home, and instead shelters should consider focusing resources on evaluating dogs' behavior in settings that more closely mirror the contexts they would be in once they are adopted (e.g. walking on the leash, playgroups with other dogs, engaging in training) (Patronek & Bradley, 2016).

In a broader context, Kaspersson (2008) argues that breed is not an accurate predictor of aggression in dogs because of the overriding differences between each individual dog and their living circumstances. A study by the United States Centers for Disease Control (CDC) found that 84% of incidents with dogs that resulted in harm to humans or other animals were a result of negligent owners who tethered or otherwise inappropriately confined their dogs or permitted the dogs to play with children without adult supervision (MacPherson, 2016). Lockwood and Rindy (1987) addressed five factors that interact to influence a dog's tendency to bite, which include a dog's genetic predisposition to aggression, history of socialization, training for obedience or fighting, quality of care received as well as supervision, and the bite victims' behavior at the time of the incident. Franklin (2013) found that dog training experts identify human action and responsible pet ownership as critical variables to addressing dog behavior.

Due to the existing research on breed identification and behavioral assessments, a number of national animal welfare organizations have advocated for laws that focus on the actions of the owners rather than banning a specific breed of dog altogether (Van Kavage, 2009; AVMA Task Force on Canine Aggression and Human-Canine Interactions, 2011). By understanding the strengths and limitations of the evaluation process, DAS is capable of making informed decisions regarding an animals' suitability to be placed back in the City and County of Denver community, regardless of breed. To assess the degree to which DAP has been fulfilling its duty to protect the human and animal residents of the Denver community, the research team assessed the impacts of BSL on a variety of measures of public health.

Impacts on Public Health

Animal control agencies serve at the intersection of human and animal systems, however, animal-related nuisances are often a manifestation of human health concerns or conflicts. Therefore, animal control policies have as much to contribute to the health of human communities as they do to animal welfare outcomes. The effects of BSL on public health were assessed through an extensive literature review on the social impacts of dogs in communities and an analysis of data from DAP on standard public health metrics for animal control agencies (dangerous dog citations, dog bites, and leash laws).

Impacts on Dangerous Dog Citations

According to Section 8-63, 8-64, and 8-52 of the Denver, Colorado - Code of Ordinances, an individual may possess a dog of any breed that has caused bodily injury to a person, domestic animal, or livestock within the city as long as they have a dangerous dog permit. Dangerous Dog laws acknowledge that any breed of dog can be dangerous and strive to caution individuals who may come in to contact

with aggressive dogs. Dogs in the City and County of Denver that are categorized as dangerous (have killed another animal or injured a human) are required to have signage identifying the potential danger of the dog and are regularly monitored by animal control officers (Colorado Code of Ordinances). The dog must also be confined within an escape-proof location on the property, such as an enclosure that is secure with sides and a top or with sides that are above eight feet high (Colorado Code of Ordinances). As of July 2018, these ordinances were revised to allow for two separate classifications of dogs as either "potentially dangerous" or "dangerous," with different levels of enforcement based on these classifications. In the City and County of Denver, the number of individual dogs who have been identified as "dangerous" and then violate these court orders (thus receiving an 8-52 citation) are generally a relatively small number of individuals (Figure 8).

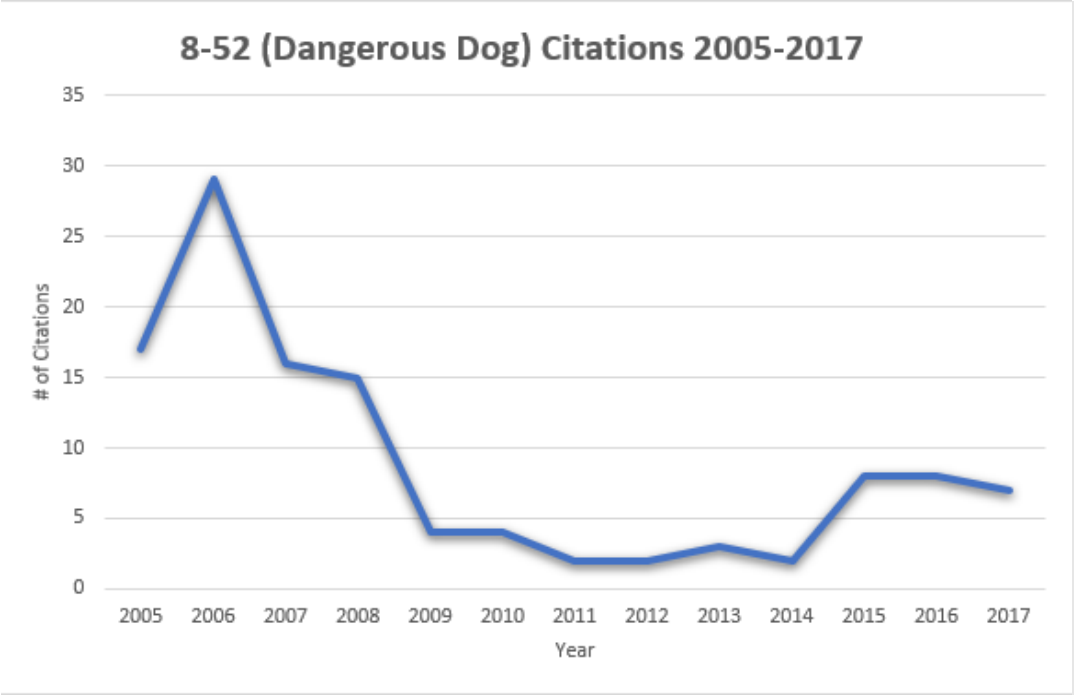

Figure 8. Section 8-52 (Dangerous Dog) Citations from 2005-2017. Note: DAP was only able to provide data on these citations from 2011 to 2017. Data obtained prior to 2011 was obtained by *Westword* journalist Jared Maher via public records requests.

The decreasing rate of Dangerous Dog citations is congruent with the observed decrease in restricted breed intake at DAS, which may indicate that the overall state of public safety related to dangerous dogs in Colorado is improving. However, no conclusions can be drawn, based on this data, on if BSL specifically is driving these decreases in dangerous dog citations. In theory, BSL acts as a supplement to the more general Dangerous Dog laws by banning the specific breeds of dogs who are more likely to be dangerous. Studies suggest that legislation that goes beyond identifying potentially dangerous dogs, and instead takes into account the responsibility of the dog owner in the provision of proper training and care for their animal, may be more effective (Burnstein, 2004). While dangerous dog citations may prevent future harm to other humans or animals, they do not address the human social issues that drive the incidence of behaviorally challenged dogs or dogs left unattended.

Impacts on Dog Bites

One of the primary goals of breed ban policies is to reduce human injuries from animals through the prevention of dog bites. Given that dogs can inflict serious harm, there is a significant number of

studies investigating the factors informing dog bite trends. A consistent research finding is that children, particularly children under 10, are much more likely to be involved in dog bites than any other age (Cornelissen and Hopster, 2009; Golinko, Arslanian, and Williams, 2016; O'Brien, et al. 2015; Ó Súilleabháin, 2015; Sacks, Krenow, and Houston, 1996). Additionally, dogs familiar to or owned by the victim are most often the culprit in dog bite incidents (Cornelissen and Hopster, 2009; O'Brien, et al. 2015). One study also found that hospitalization due to dog-bites was more likely to occur in rural communities and in communities with lower socioeconomic status (Raghavan, Martens, Burchill, 2014). Schuler et al. (2008) revealed that biting dogs were more likely to live in neighborhoods where the residents' median incomes are less than the median income of the county. However, there is currently no research that has identified the relationship between the prevalence of dog bites and factors such as increased number and density of dogs, the types of dogs in these neighborhoods, inconsistent enforcement practices across communities, and/or the availability of resources.

Many studies have attempted to identify which breeds of dogs are more likely to bite, but the conclusions are inconsistent. For instance, Schalamon and colleagues (2006) found that German Shepherds and Dobermans were significantly more likely to bite than other breeds. In addition to German Shepherds, Hanna & Selby (1981) found Collies and Cocker Spaniels are responsible for biting most frequently. Another study found pit bulls as the most prevalent breed in dog bite incidents (Golinko, Arslanian & Williams, 2016). However, Vankavage (2009) found PBTDs to be the perpetrator in only 4% of dog bite reports. In Denver from 2007 to 2017, the following breeds were consistently among the top 10 breeds reported in bite cases: German Shepherd, Labrador Retriever, Chow Chow, Chihuahua, Boxer, Rottweiler, Pitbull, American Bulldog, Poodle, and Unknown (Figure 9). Given the lack of agreement among dog bite studies, some experts, including the American Veterinary Medical Association (AVMA), feel that breed may not be the best indicator in assessing risk factors for dog bites (AVMA, 2001; Medlin, 2007).

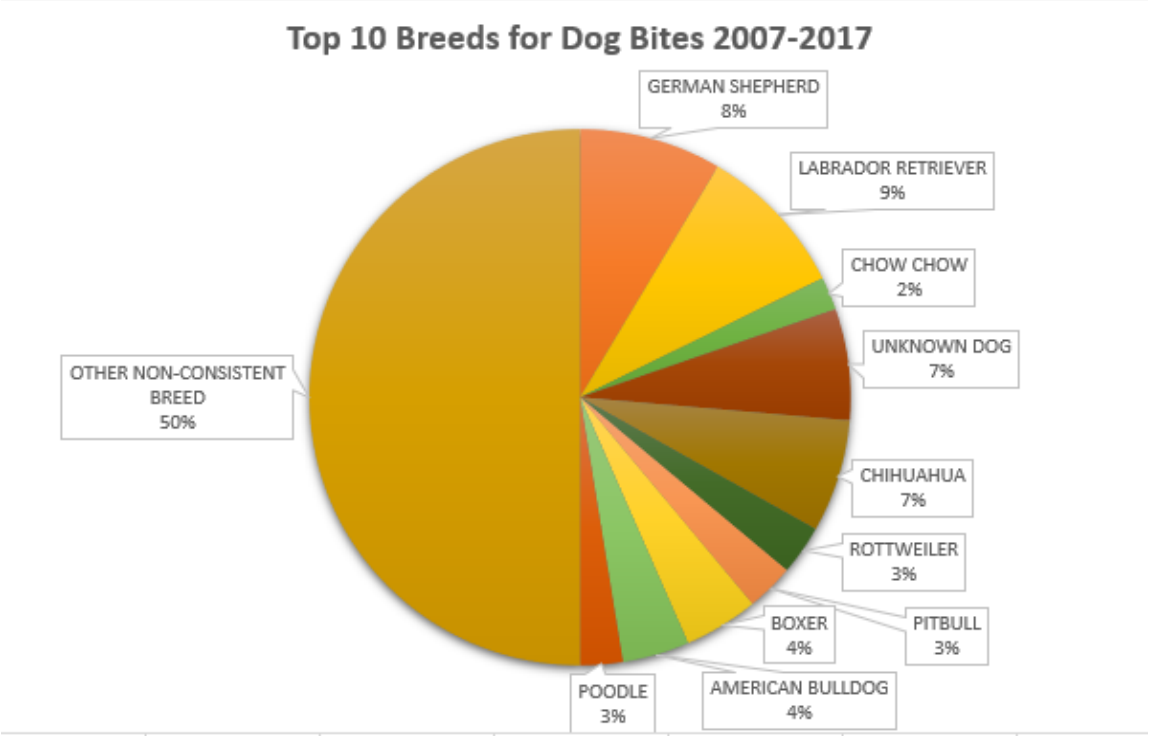

Figure 9. Top 10 Breeds in Denver Bite Cases 2007-2017.

It is difficult to determine which breeds of dogs are more likely to bite, particularly due to issues with data collection and reporting on dog bites. Unfortunately, there is no uniform system for collecting and verifying dog bite reports in the United States and there is no reliable data available that reports on number of dog bites by breed (Medlin, 2007). There is also the issue of how to accurately report on the incidence of bites by mixed breed dogs (e.g. accurately identifying and then reporting on the breeds that a mixed breed dog consists of in bite cases). Furthermore, there may be bias in breed specific dog bite data due to the over reporting of bites related to specific breeds, challenges in breed identification, and inaccurate reporting of number of specific breeds in the overall pet population (Lockwood & Rindy, 1987). The AVMA (2001) cautions that when data is collected on breed regarding a dog bite incident, the breed of dog is seldom reported accurately. Since large dog breeds tend to cause more serious injuries that require medical care when they bite, they are likely overrepresented in reported dog bite incidents (Borchelt, Lockwood, Beck & Voith, 1983). O'Brien et al. (2015) found that individuals are more likely to report the breed of the dog involved in the incident if they think it's a PBTD, and they often report it as a PBTD when it actually is not. Reporting bias against PBTDs appears to be perpetuated through the frequency of media coverage on bite cases involving PBTDs (Twining, Patronek, & Arluke, 2000). Golinko, Arsianian & Williams (2016) advocate for independent verification of the dog's breed when data is collected from medical records.

The Coalition of Living Safely with Dogs completed a study on dog bite data in Colorado from July 2007 to June 2012 with 22 animal control agencies (CLSD, 2013). There were 11,484 bites that were recorded over the 5 years, and 8,449 of those bites were from the same set of 11 agencies that reported throughout the whole study. Based on the number of households in the study jurisdictions and estimates of the number of dogs per household, approximately 952,177 dogs were included in the

study. The most notable findings of this study included that less than 1% of all dogs in the community were involved in a reported bite incident, only 0.6% of reported incidents consisted of a mauling or fatality, and most bites were preventable. The study showed that 57% of all bites occurred at home, whether that be inside or outside, and over 70% of bites were considered a minor bite level. There was not enough information gathered through the study to conclude if one breed of dog bites more often than another. However, the study identified 93 breeds of dogs who appeared in bite case reports 10 times or more. Consistent with the literature, the most likely victim of a dog bite was a child under 10 years old, with approximately 25% of all bites occurring in that age range. From this data, it can be concluded that in Colorado the general incidence of dog bites are very low, children are most likely to be bitten, and a wide variety of breeds are perpetrating the bites (CLSD, 2013).

According to Section 8-51 of the Denver, Colorado Code of Ordinances, no dog is permitted to attack or bite another animal or a person on any private property or in public. The 8-51 citation is a criminal charge with a substantial penalty associated with it that is issued and reported for all breeds of dogs. An 8-51 citation could also lead to a "dangerous dog" designation. While 8-51 citations could be an indicator of the number of potentially dangerous animals in Denver, these citation numbers are not necessarily the only indicator of an aggressive dog. Some bite cases could ultimately be an isolated incident that does not escalate to the level of a dangerous dog citation. The research team assessed the trends in the City and County of Denver's 8-51 citations from 1990-2017 by compiling data from two sources (Figure 10)[10]. Based on the available data, there has been an overall decrease of 83% in the number of 8-51 citations over the 27-year period ($p<0.01$). However, there have been decreases in these bite citations for all breeds of dogs, so no conclusions can be drawn on the specific impacts of BSL in informing this downward trend.

[10] Denver Animal Protection noted a number of challenges with drawing conclusions from the data for dog bites over this period, including input errors, inconsistent data cleaning efforts, and changes in data collection systems. Beginning in 2005, a dedicated staff person was hired to manage all data, and therefore trends seen following 2005 are considered to be more reliable. Additionally, in 2005, the definition of a bite was re-defined as a citation following a bite, not just a bite that went to the hospital in order to streamline and standardize data collection.

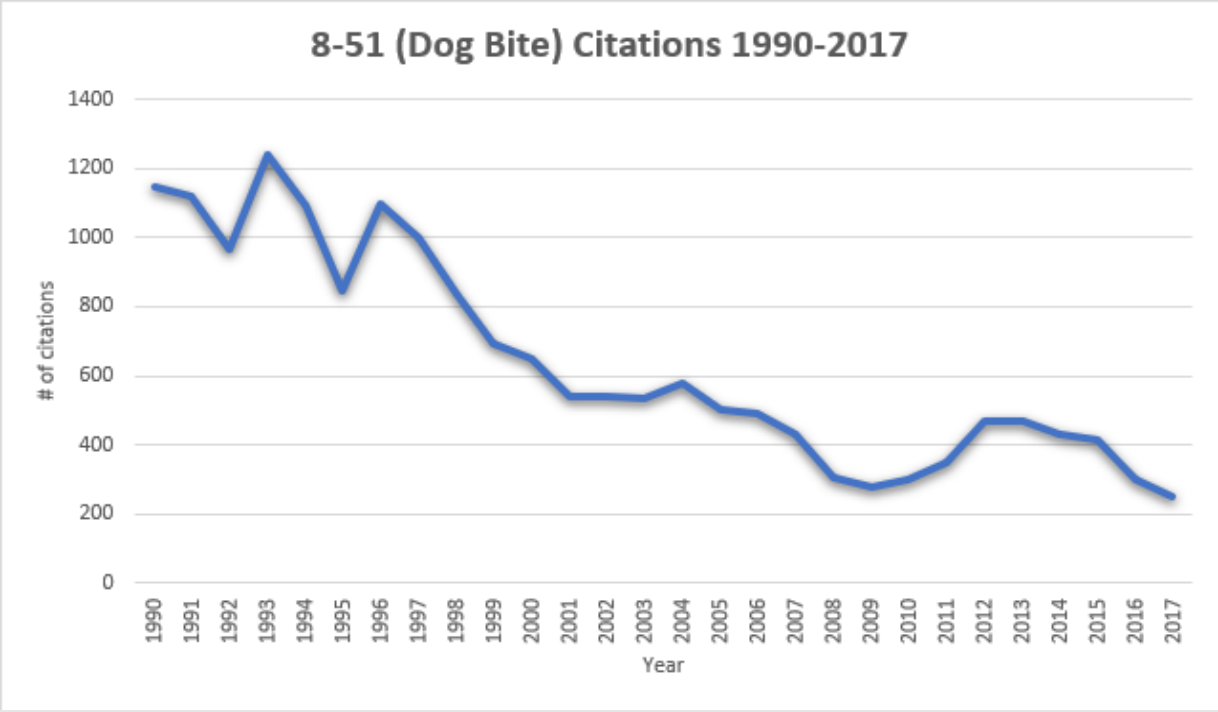

Figure 10. Section 8-51 (Dog Bite) Citations. Note: DAP was only able to provide data on these citations from 2011 to 2017. Data obtained prior to 2011 was obtained by *Westword* journalist Jared Maher via public records requests.

While dog bite incidence in the City and County of Denver has decreased since 1989, it is unclear how other factors may have informed this trend. The literature suggests that the implementation of more comprehensive dangerous dog laws, such as routine monitoring of all "dangerous dogs" by animal protection officers could positively impact rates of dog bites (Patronek, Slater, and Marder, 2010; Reese and Remmer, 2017; Creedon and O'Suilleabhain, 2017). The changes in the City and County of Denver's Dangerous Dog policies over the study period limit the ability to draw conclusions on the effectiveness of BSL specifically in decreasing these rates. The variety of breeds (including German Shepherds, Labrador Retrievers, Chihuahuas, and PBTDs) consistently reported in dog bite reports over the study period indicate that dog bites appear to be decreasing across all breeds in Denver. Without reliable estimates of the number of PBTDs in Denver prior to BSL to compare to the current data, no firm conclusions can be drawn about the role of BSL in informing the downward trends in dog bites in Denver.

Impacts on Leash Law Violations

Within Section 8-16 of the Code of Ordinances for the City and County of Denver, CO, there is a description of the leash laws. It states that owners are responsible for preventing their pets from running at large. A dog is categorized as running at large when it is not on a leash, cord, or chain held by the dog owner or appropriately confined on the owner's premise. This would not include situations when a person over the age of 18 is supervising their dog within a designated off-leash enclosure. When an officer encounters an individual with their dog off leash or receives reasonable information about a violation of the law, they must issue a summons and complaint. If a dog is found roaming off-leash by the police or an animal patrol officer, the dog can be placed in a municipal animal shelter (Colorado Code of Ordinances).

While the purpose of this law is to help keep the community safe, few studies have evaluated the practicality of the law. One study conducted in North Carolina, showed that 76% of visitors to public land knew there was a leash law, but 48% allowed their dogs to be unleashed (Jorgensen & Brown, 2017). Additionally, 15% of visitors that had unleashed dogs agreed with the statement, ”It is my choice how I walk my dog.” Similarly, most visitors with dogs thought that having their dog unleashed had little to no consequences and believed that their dog’s behavior in general could not have negative consequences (Jorgensen & Brown, 2017).

Although people may feel it is safe to have their dog off leash, the research justifies the need for leash laws as a means for protection. One study examining dog bites from 1979 through 1998 found that less than one half of 1% of the fatal dog bites came from leashed dogs not located on the dog’s property, demonstrating that leashing dogs can prevent fatal dog attacks (Sacks, Sinclair, Gilchrist, Golab & Lockwood, 2000). According to Colorado’s Coalition for Living Safely with Dogs, 57% of dog attacks occurred off leash at home and just over 15% of attacks occurred when a dog was off-leash at large in Denver (CLSD, 2013).

Increasing public education on the importance of leash laws is considered more effective than ticketing under most circumstances, and DAP has seemed to adjust their practices to increase their outreach tactics accordingly (Jorgensen & Brown, 2017). This shift could be considered partially responsible for the decrease in violations of the leash law (Figure 11). There has also been a decrease in the number of leash law violations in Denver because of the discontinuation of the “bike patrol” program in the parks. Officers who formerly held this position patrolled parks and issued citations primarily for leash violations. Because many people do not understand why they have to keep their dogs on a leash, providing educational programs supplemented with enforcement has the potential of being much more successful in gaining widespread compliance of the law (Jorgensen & Brown, 2017). In summary, given that animal control ordinances like leash laws prevent dogs from running at large and require owners to have control over their animals, they are strategies that can be used as an effort to decrease dog bites from all breeds.

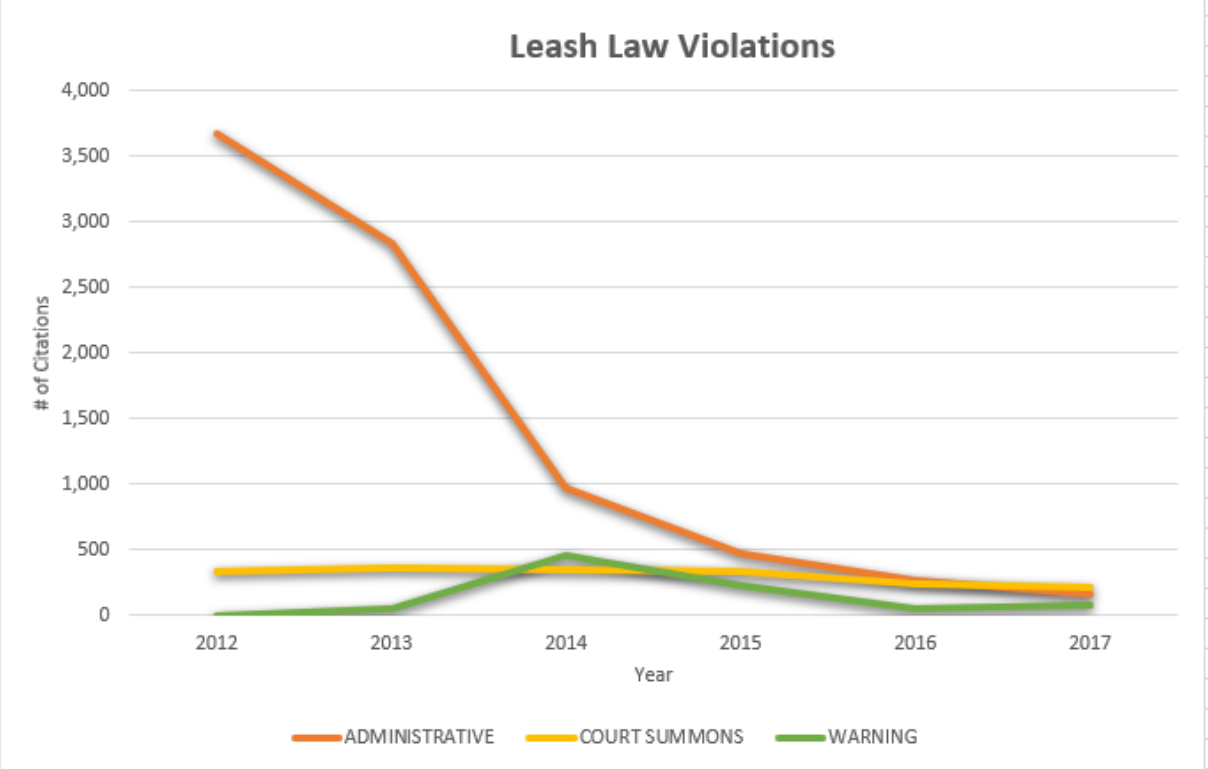

Figure 11. Section 8-16 (Leashing) citations.

Social Impacts of BSL

Pet-keeping plays a variety of important functions in today's society. These functions include: maintaining individual physical and mental health, contributing to social capital, and facilitating social cohesion. PBTDs, like other dogs in communities, have also played important community roles by serving as companions, therapy dogs, assistance dogs, search and rescue dogs, police dogs, and drug detection dogs (MacPherson, 2016). By removing PBTDs from communities, BSL prevents these dogs from serving in some of these more beneficial community roles and may, therefore, hinder a community's ability to accrue these important benefits for its residents.

In order to begin assessing the social impacts of the breed ban ordinance in the City and County of Denver, the research team conducted an online survey using a random sample of Denver residents (n = 252). While a larger sample of Denver resident would help further define if the perspectives reported below are salient throughout the population, the responses of this smaller group of residents are provided to advance the discussion of the social impacts of BSL. In this survey, 86.1% (n=252) of respondents stated that they were aware of the breed ban ordinance in Denver. After establishing the level of awareness of the policy in the community, the research team then assessed Denver residents' general sentiments regarding the policy. When asked whether BSL impacted the residents' opinion of the City and County of Denver, responses varied widely, with 46.4% stating the legislation does not change their opinion, 32.9% stating the legislation negatively changed their opinion, and 19.4% stating the legislation positively changed their opinion (Table 1). These responses indicate that very few Denver residents (19.4%) are strongly in favor of BSL.

Table 1. Impact of BSL on Denver Residents' General Opinion of the City and County of Denver.

Does BSL Affect Your Opinion of Denver?	Number of Respondents (n = 252)	% of Total
No, it does not change my opinion	117	46.4%
Prefer not to answer	3	1.2%
Yes, negatively	83	32.9%
Yes, positively	49	19.4%

Impacts on Community Cohesion

As previously articulated: "While animal control ordinances are written mainly to protect human lives and property, reasonable animal control law enforcement consists mainly of trying to improve human relations within a community by removing reasons why neighbors fight." (Clifton, 2002). While BSL aims to remove certain breeds of dogs from the community, the increased presence of animals in a community has been connected to an overall increase in community cohesion and overall sense of safety (Wood and Giles-Corti, 2008). An emerging body of evidence is pointing to the ways in which companion animals can act as a social bridge between people and ultimately contribute to tying communities together as a civil society. Johnson et al (2011) describe six possible mechanisms through which dogs and dog walking can impact community health by influencing the social fabric of a community, which include: social interaction, formation of friendship, social support, civic engagement, visible community presence, and healthy and social urban design.

Dogs often serve as a social lubricant, by transcending racial, cultural, geographic, age, and socioeconomic boundaries, which can play a significant role in building trust and sense of community at the neighborhood level (Wood, 2010). Rossbach and Wilson (1989) found that being photographed with one's dog made one appear more likeable as well as improved their social interactions. Additionally, individuals walking with a dog are far more likely to experience social contact and conversation with strangers, compared to solitary walkers (McNicholas and Collis, 2000). Dogs can normalize social interaction, provide a conversation starter or topic, and increase likelihood of perceived friendliness (Wood, 2010). Wood, Giles-Corti, and Bulsara (2005) found that 50% of dog owners report that they get to know people in their neighborhood as a result of their dog, with about 84% of dog owners reporting that they talked to other dog owners while walking their dog. In the same study, pet-owners reported experiencing more favors performed for or by a neighbor than non-pet owners (Wood, Giles-Corti, & Bulsara, 2005). Such human interaction may contribute to a greater "sense of community," which suggests that the presence of dogs may serve as a protective factor for community cohesion and may influence individuals' attitudes towards their local community members and the community itself.

Furthermore, the presence of dogs in a community is believed to influence the perception of safety in a community. In one study, the visible presence of people "out and about," including dog walking, was identified as a positive marker of community safety. On the other hand, deserted streets and parks conveyed negative impressions about safety, crime, and general sense of community (Wood et al., 2007). Another study concluded that the visible presence of dogs being walked, the accompanying social exchanges, and the impetus dogs provide for people to be out walking in the streets and parks, all contribute to increased feelings of collective safety and perceptions of sense of community (Wood et al., 2005). It is important to note that none of the research tying the presence of dogs to a sense of community cohesion and safety includes an assessment of the relevance of breed.

Sense of safety appears to be a primary driver behind BSL in the City and County of Denver (Maher, 2009). Results from a 2013 Gallup Poll (Jones, 2013) indicate that 78% of Denver residents (n = 3,506) report feeling safe walking alone at night, ranking second in the country (Jones, 2013). In the research team's survey of Denver residents, 24.6% of respondents (n = 252) said that the City and County of Denver's breed ban makes them feel safer (Table 2). While in the minority of opinions, this perceived sense of safety that comes from the removal of PBTDs from communities demonstrates the negative association with PBTDs and contradicts research that supports the idea that dogs in communities have positive impacts on community and individual sense of safety.

Table 2. Impact of BSL on Denver Residents' Sense of Safety

Does BSL Make You Feel Safer?	Number of Respondents (n = 252)	% of Total
I am neutral	55	21.8%
No, it does not make me feel safer	134	53.2%
Prefer not to answer	1	0.4%
Yes, it does make me feel safer	62	24.6%

While BSL makes some residents of the community feel safer, the removal of PBTDs from homes in the City and County of Denver present tremendous implications for individuals who choose to keep PBTDs as companions. Some of the protective factors for these individuals, including their sense of community, social cohesion, and social capital may be inherently at risk upon the impoundment of any dog due to BSL (Zimolag & Krupa, 2009). In one study PBTD owners reported that when they were with their dog, community members would appear frightened or nervous. Owners frequently experienced situations in which people would try to avoid coming near the PBTD by walking around or crossing the street, and in some cases, individuals would refuse to visit the home where the PBTD resided. These actions and remarks recalled by owners reflected the theme that people expected PBTDs to be dangerous, untrustworthy, and erratic (Twining, Patronek, & Arluke, 2000). More research in this area is needed to assess the negative social impacts of BSL on the individuals who keep PBTDs.

Impacts on Underserved Communities

In a survey of Denver residents conducted by the IHAC research team for this study, 19.0% of Denver residents randomly surveyed (n = 252) said that they had been impacted (either directly or indirectly) by the City and County of Denver's breed ban (Table 3). These results indicate that only a minority of individuals in Denver continue to experience the impacts of the City and County of Denver's BSL, as of 2017.

Table 3. Denver Residents' Report of Being Impacted by the City and County of Denver's BSL.

Have you been personally impacted by BSL?	Number of Respondents (n = 252)	% of Total
Not Impacted	204	81.0%
Impacted	48	19.0%

Enforcement of BSL in the City and County of Denver as of 2017 appears to be focused in specific areas of the community. The research team's analysis of the locations of complaints received regarding the presence of PBTDs in Denver in 2017 identified that they were most likely to occur where racially diverse communities intersect with predominantly White neighborhoods[11] (Figure 12). The top five zip codes in 2017 with complaint calls related to PBTDs included: 80219, 80204, 80239, 80223, and 80212 (Appendix C). Furthermore, the communities in Denver experiencing the highest BSL-related call volume and enforcement have also been identified by DAP as communities that also experience challenges to accessing pet supportive services such as veterinary care, pet supply stores, and spay/neuter services (Denver Animal Protection, 2019).

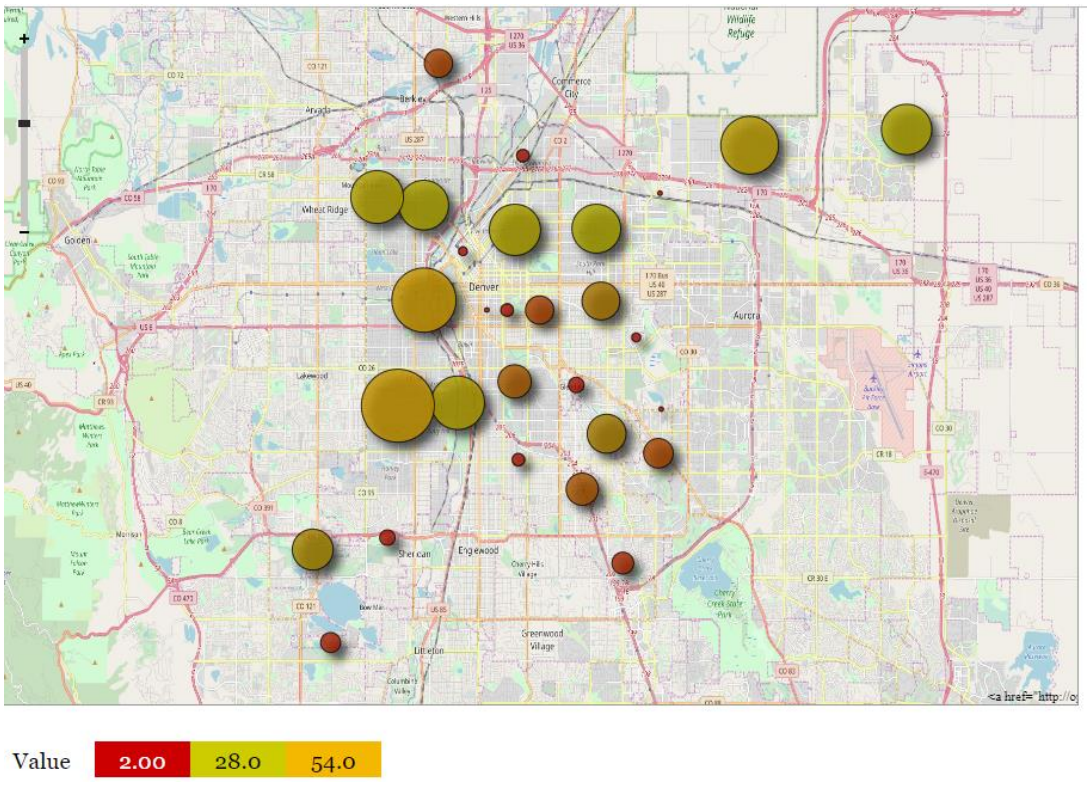

Figure 12. 2017 8-55 Complaint Calls by Zip Code

The locations of the enforcement of BSL indicate that animal welfare issues such as the presence of "dangerous dogs" may be driven by similar challenges to social cohesion as other social issues such as

[11] http://mapbrief.com/co-census/

gentrification (Tarver, 2014; Gilliam Jr., Valentino, and Beckmann, 2002). For example, Arluke (2003) argues that BSL is an example of how racial profiling by police can become normalized and justified so that it develops into standard enforcement policy and practice. A recent study of NYPD-referred 311 calls highlights the ways in which gentrification (an influx of white residents into lower income, majority persons-of-color neighborhoods) coincides with an increased volume of "quality of life" calls such as noise complaints (Community Service Society New York, 2019). It is important for policymakers to identify these factors that may be negatively impacting relationships in their communities and adjust policies accordingly.

While there are a number of factors that could inform the location of BSL enforcement, it is important to acknowledge the ways in which overpolicing, particularly in communities with limited access to resources, can exacerbate existing health challenges for both humans and animals. Diminished access to resources has resulted in negative consequences like being accused of animal cruelty, abuse and neglect or served with fines or criminal charges (Arrington & Markarian, 2017). As a response to the negative association with PBTDs that is fostered by BSL, many homeowners' insurance companies refuse to provide coverage to households with dogs that fall within the list of restricted breeds (Coren, 2009; Cunningham, 2004). One study found that PBTD owners are more likely to maintain a low profile in their community to avoid authorities, while others may choose to relinquish their dog (Cunningham, 2004). Finally, lack of access to veterinary care in underserved communities can result in prolonged illnesses and recovery, increased likelihood of being relinquished to an animal shelter, and an increased risk for euthanasia (White et. al, 2018). While BSL is primarily an intervention for the presence of dangerous dogs in communities, policy makers may wish to consider the additional implications of enforcing BSL in underserved communities.

Economic Impacts

BSL has been in place in the City and County of Denver for over three decades, making measuring the economic impacts of this policy challenging due to incomplete or unavailable data, changes in data collection practices, variable definitions, and other mitigating factors. To begin assessing the economic impacts of BSL in the City and County of Denver, the research team asked a random sample of Denver residents to share what they believed the cost of BSL to be. A majority (64.8%) of respondents indicated they believed BSL costs less than $250,000 per year (Table 4). These data demonstrate the limited awareness of a typical resident around the true costs of enforcing such a policy and the need for a more detailed assessment.

Table 4. Responses from Denver residents on the perceived cost of BSL

How Much Do Respondents Believe BSL Costs Annually? (n = 252)		
Less than 100K	85	33.6%
100K to 250K	79	31.2%
250K to 500K	50	19.8%
500K to 1M	25	9.9%
> 1M	14	5.5%
*One respondent checked both [100 - 250] and [250 - 500] options.		

In order to determine the economic impacts of BSL in the City and County of Denver, the research team needed to assess the total number of dogs impacted by the policy since 1989. Therefore, the total pet-keeping population of Denver and the proportion of those pet-keeping households with PBTDs was estimated These estimates were then used to measure the pet care related revenue that would be lost to Denver's local economy due to BSL restrictions on the presence of PBTDs in the City and County of Denver (lost revenues that would have been spent on the local economy otherwise). Additional costs related to the enforcement of BSL were considered, including additional staffing needs such as additional animal protection officers or shelter personnel, kenneling of PBTDs at DAS, euthanasia of PBTDs determined to be unsuitable for placement back in the community, and the legal costs of citations under the City and County of Denver's Section 8-55 ordinance that resulted in criminal and/or civil litigation. Finally, the impact of BSL on surrounding communities were considered. Throughout the study, conservative assumptions on missing data and estimation approaches were used. Therefore, the findings represent very conservative estimates given the available data.

Estimating the City and County of Denver's Rate of Pet-Keeping

In order to estimate the economic impact of BSL in the City and County Denver, there were two variables of interest for this section of the study: (1) an estimation of the dog ownership rates in Colorado and, then more specifically, in the City and County of Denver; and (2) an estimated percentage of PBTDs in Denver. Both of these variables were then used as part of the cost estimation procedure, which is described in further detail below.

U.S. and Colorado Dog Ownership Estimation 1989 - 2017

The original data set on U.S. rates of dog ownership is nationally available from two sources, the American Pet Products Association (APPA) and the American Veterinary Medical Association (AVMA)[12]. APPA conducts ownership studies every two years while the AVMA conducts ownership studies every five years. These organizations use different methods for estimating dog ownership rates at the household level, as evident from the differences in observed rates for years where both data sets were available. To maintain consistency and keep the estimation conservative, AVMA's method was adopted (yielding lower dog ownership percentages than APPA data). The missing years for AVMA data were estimated using year-to-year percent changes in the APPA data and applying those percentages to the AVMA data.

Even after scaling and merging APPA data with the AVMA data, certain years were still unavailable since neither source covered all years. For the remaining missing years, estimated ownership rates were computed using the linear interpolation method[13], which provided annual U.S. dog ownership rate estimates from 1986 through 2017[14].

Next, Colorado specific dog ownership data for years 1996, 2001, 2006, and 2011 were collected from the 2012 AVMA sourcebook. For those four years, dog ownership rates in the state were 19% above the national averages (AVMA, 2012). Therefore, assuming the 19% difference was stable

[12] APPA & AVMA data for partial years within 1986 - 2014 time period was obtained from Dr. Andrew Rowan - Chief Science Officer, Humane Society United States.

[13] Assuming equal year to year increments over a certain number of missing years.

[14] For 2015 through 2017, the research team extrapolated dog ownership rates using previous 5 years averages.

throughout the entire time period, the Colorado dog ownership rates were estimated using the national dog ownership rates from 1986 through 2017 by scaling national numbers up by 19% (Appendix D).

City of Denver Dog Ownership Estimation

Since BSL policy does not exist statewide, in order to calculate the economic impacts of BSL in the City and County of Denver, the Denver dog owner population was estimated. While there are no publicly available sources that estimate dog ownership rates in Denver over time, a 2017 Realtor.com survey reported a 42.5% dog ownership rate in Denver. Given that the underlying survey data was not available[15], a conservative adjustment was made by taking the Colorado dog ownership rate downwards by a factor of 44.5 / 42.5 = 0.96 for each year to estimate the dog ownership rate in Denver (Appendix E)[16].

PBTD Type Dogs Estimation:

Since BSL specifically targets PBTDs, the associated costs of BSL were estimated as a function of the number of PBTDs in Denver. As part of the effort to understand the percentage of PBTD dogs in the City and County of Denver, multiple estimates of PBTDs as a percentage of total dogs owned were found from various sources (Clifton, 2016; Wilson, 2019; Dunham et. al., 2012; Pitbull.org, 2019). These estimates ranged from 5% to 20% of total dogs, but none of the sources describes their methodology for collecting data. Therefore, none of the located resources was assessed to be more reliable than others.

Given the lack of reliable third-party data on the percentage of PBTD ownership in the City and County of Denver, the research team utilized the rate of PBTD intake at DAS in order to accurately estimate the PBTD ownership rates in Denver. The average number of PBTD intakes as percentage of total intakes (all breeds) from 2007 to 2017 at DAS was calculated to be 4.4% for the City of Denver. It's important to note that DAS intake data is subject to two potential biases. One is the fact that BSL has been in effect for three decades in Denver and the observed PBTD rates are potentially lower than would be in the absence of BSL. In other words, 4.4% is a lower estimate for what the PBTD ownership rates would be in a BSL-free Denver area. On the other hand, it is possible that observed PBTD intake numbers over represent the true percentage of PBTDs in the city, since DAP dog intakes are likely more targeted towards PBTDs. Therefore, the two bias factors for the DAS intake data move in opposite directions, indicating that the 4.4% DAS intake rate is the most reliable estimator for the PBTD ownership rates for calculating lost revenues to the city.

As the last step for estimating the number of PBTDs in the City and County of Denver, the U.S. Census (U.S. Census Data & Information) data was used to determine the annual number of Denver households and then multiplied by the estimated dog ownership rate in Denver. The AVMA survey data states that an average dog owning household owns 1.6 dogs (AVMA, 2012). Therefore, 1.6 was applied to the estimated number of dog-owning households in Denver. Finally, the estimated number of dogs in Denver was multiplied by 4.4% (PBTD population percentage), to obtain the estimated number of PBTDs in the City and County of Denver for purposes of the lost revenue calculations.

[15] The research team requested this data using (https://www.realtor.com/research/data/) but no response was received from Realtor.com.

[16] 44.5 is the AVMA's estimated 2017 household dog ownership rate for Colorado

Impact on Pet Care Revenue

The city of Denver has most likely lost business revenues on pet care services as a result of BSL. Specifically, existing owners of PBTDs in Denver may be less likely to utilize local resources for their veterinary, grooming and boarding services to avoid the risk of their dogs being reported to DAP (although none of these groups are mandatory reporters). Denver residents with PBTDs may spend such expenses in the surrounding communities where PBTDs are legal and owners feel safe, which means that such related forgone expenses are lost revenues for the Denver economy. This same argument follows for the forgone PBTDs in the community (i.e. PBTDs that would have lived in Denver but for the BSL). Since data was not available to determine the true number of PBTDs that would have existed in Denver but-for the BSL (and also could not account for the number of individuals who may have chosen to keep a PBTD but-for the BSL), the 4.4% PBTD ownership rate was used as a very conservative figure for the lost revenue estimation.

Two separate approaches were used to estimate the BSL related forgone revenues to the City of Denver. For the first approach, estimated number of PBTDs were multiplied with the average per dog spending that could have remained within Denver, in absence of BSL. For the second approach, total size of the veterinary and pet care related industries were used as the starting point, and then apportioned by the percentage of PBTDs in Denver.

For the first approach, the 2014 APPA pet industry expenditure data was used to determine which 'per dog' expenditures were most likely spent outside of Denver by PBTD owners. "In-person" costs such as grooming, boarding/pet sitting, and medical care were included. For example, if PBTD owners utilized non-Denver businesses in the year 2014 (the most recent APPA pet industry expenditure report year), Denver's local economy could be expected to have lost the following revenues: $61 per dog on grooming, $327 per dog on boarding/pet sitting, and $239 per dog on medical care. Other expenditures that would not necessarily have been impacted by the BSL in Denver (because they would not require the individual to present their PBTD in-person for services) include: licensing, which amounts to $7 per dog, food at $231 per dog, treats at $65 per dog, and toys at $41 per dog.

The estimated number of PBTDs in Denver was used to calculate the total forgone pet related expenditures in Denver's economy since the implantation of BSL in 1989 around the services previously mentioned (medical, grooming, and boarding / pet sitting services). Since these AVMA reported annual spend estimates were in 2014 dollars, the lost revenue was then deflated by Consumer Price Index (CPI) indices germane to pet services and medical costs (Appendix F).

The estimation method described above yields $4.9 million per year forgone spending related to the PBTDs in Denver, as measured in 2017 dollars. In order to check the reasonableness of these figures, a second approach was employed using data collected from the Census' County Business Patterns (CBP) database for the County of Denver on the two relevant industries of Veterinary services and Pet Care services. Once the estimated sales for the entire industry was calculated using CBP data[17], the data was apportioned from total expenditures to dog-only-related expenditures using AVMA statistics of 68% dog ownership rate (AVMA, 2012), and the estimated Denver PBTD population of 4.38%. These calculations resulted in $2.55 million in estimated sales lost from PBTD owners (Appendix G).

[17] Estimation of sales is conducted using 2012 annual payroll to annual sales information for each industry in Census Fact Finder at Geographic Area Series: Economy-Wide Key Statistics: 2012 http://www2.census.gov/econ2012/EC/sector00/EC1200A1.zip . We then applied the same ratio to the 2016 CBP payroll data to estimate 2016 sales.

The $2.55 million estimate for lost sales using CBP data is expected to be less than lost expenditures estimate of $4.90 million calculated using APPA data[18]. The discrepancy between the two approaches indicate that there is most likely a reporting problem of informal economy (e.g. some college students board sitting dogs that are not registered businesses), or that some existing PBTD owners already used services that are located outside of the County of Denver (such as visiting a veterinarian located outside of Denver city borders in order avoid being reported)[19]. For such reasons, true lost revenues to the City of Denver should lie somewhere in between the two estimated numbers of lost sales ($2.6 M) vs. lost expenditures ($4.9 M). Therefore, the mid-point of the two estimates was taken for our final calculation of $3.7 million in average annual lost revenues. This estimate yields a total calculated lost revenue of $108 million over the 29 years of the City and County of Denver's BSL (Table 5).

Table 5. Denver's PBTD Related Lost Revenues/Spending Estimation

Approach	Annual Estimate	Total Lost Revenues to Denver (1989 – 2017)
Approach 1: Lost Local Expenditures Medical, Boarding and Pet Sitting, for all PBTDs	$4,906,352	$142,284,207
Approach 2: Lost Veterinary and Pet Care Services in Denver – Apportioned by % of PBTD	$2,559,662	$85,940,851
Mid-Point Estimate	$3,733,007	$108,257,203

Impact on DAP's Enforcement Costs

The implementation of BSL accrues extra expenses for DAP in the evaluation and intake of dogs who have an 8-55 (restricted breed) hold. For instance, DAP provided data stating that it takes about 5 minutes for an Animal Care Attendant or about 10 minutes for an Animal Protection Officer to conduct a general evaluation of physical health, as completed for every dog that enters the care of DAS. Additionally, each dog costs about $30/day to care for (includes: food, toys and enrichment, kennel, staff time, etc). As a result of BSL, DAS' Animal Care Attendants performed an average of 30 banned breed intakes per year (total cost of $35/year if Animal Care Attendant is paid $14/hour) and DAP's Animal Protection Officers performed an average of 130 banned breed intakes per year (total cost of $528/year if Animal Protection Officer is paid $24/hour). DAS conducts an average of 6 breed evaluations per week to screen for banned breeds (total of $22,464/year). Additionally, DAS conducts an average of 2 voluntary breed evaluations per week (total of $7,488/year).

In order to estimate the BSL enforcement costs incurred since 1989, DAP provided data on PBTD impounds and euthanasia numbers for the 2007-2017 time period. Moreover, DAP impound and euthanasia data was acquired from 1992 through 2009 from a former *Westword* journalist, Jared

[18] In an ideal economic environment, the theory would have suggested that the two approaches must yield identical figures.

[19] Economic theory suggests that under ideal circumstances, expenditure approach should yield identical figures to sales approach, if all of the expenditures are recorded officially by registered businesses.

Maher, who had obtained this data from DAP via Colorado Open Records Act (CORA) requests for a series of articles published in *Westword* in 2009 (Maher, 2009).

As the first step for estimating enforcement costs related to BSL, the overlapping portions of the two data sets (direct vs. indirect) were compared. The indirect source of data (Jared Maher) reported DAP PBTD impounds in 2007 were 459, in 2008 were 354, and in 2009 were 162. The direct source of data (DAP) reported DAP PBTD impounds in 2007 were 443, in 2008 were 361, and in 2009 were 225. After comparing the data from 2007 to 2009 that was available from both sources, it was concluded that, for impounds from 1992 to 2017, a 105.54% direct to indirect adjustment ratio would be necessary.

Because data was obtained from two sources and the data obtained directly from DAP is considered to be of greater validity, the 1992-2009 data was adjusted to address any definitional mismatch issues. The past "indirect" segment of the data was adjusted by the 105.5% adjustment factor from 1992 through 2006. Moreover, the "indirect" data were missing the years 1989 through 1991, and the year of 2004. These numbers were estimated in 2004 by averaging the years before and after, and it was assumed 1989 through 1991 were equal to 1992 levels.

Costs Proportional to PBTD Impounds: As reported in Table 7, in-house and walk-in evaluation costs were also calculated as a per impounded PBTD level[20]. Similarly, costs related to 8-55 calls were calculated at per impound level, under the assumption that the higher number of calls would be expectedly correlated with the higher number of impounds[21]. Using the per PBTD impound costs described above, the relevant cost items were calculated for each year from 1989 through 2017 using the number of PBTD impounds estimated for each year.

Kenneling Costs: In order to estimate the kenneling costs for 8-55 impounds, first the length of stay (LOS) per PBTD in the shelter was estimated. LOS data were provided from DAP from 2007 through 2017, but not prior to 2007. The average LOS per PBTD from 2007 to 2017 was calculated as 13.7 days. Since no better estimate was available, the 13.7 days was used as a proxy for the LOS for all previous years. Kenneling costs were then estimated by multiplying the average LOS at each year by the number of impounded PBTDs. DAP indicates that the average kenneling cost per day per PBTD is $30.

Case Prep and Court Costs: DAP also reported the number of PBTD related citations for years 2016 and 2017 directly. The number of citations from 1992 through 2000 were estimated indirectly. Using the available data for overlapping time periods, the ratio of PBTD citations to PBTD impounds for 4 years[22] was calculated. It's important to note that these ratios are significantly different from each other and can be interpreted as a signal for enforcement changes in DAP[23].

[20] DAP provided consistent data on PBTD impounds but could not provide an estimate of any changes in actual costs year to year.

[21] Data was not available on the number of calls received throughout the study period. The 8-55 related call volume was calculated based on a yearly average of 535 calls in the 2015-2017 data.

[22] Indirect DAP impound data was available from 1999 through 2009. Indirect DAP citations data was available from 1992 through 2000. There were only 2 years (1999-2000) overlapping across the two variables, hence the impounds to citations ratio was calculated for those two years only. Similarly, 2016 and 2017 are the only years for which PBTD citations data was available, hence only overlapping years for direct DAP citations and impounds data are 2016 and 2017.

[23] Note that the estimation in this section excludes defense costs in courts related to lawsuits involving DAP.

According to DAP there are a variety of costs related to impoundment due to BSL (Table 6). Because some of the DAP cost items were reported at the annual aggregate level (as opposed to per impound PBTD level) some figures provided by DAP were converted to "per impounded PBTD."

Table 6. Summary of costs related to PBTD Impoundment (as of 2017).

DAP Costs	Estimated Cost	Frequency[24]
Cost Per Intake[25]	$6.00	Per Impound
Kenneling Costs	$30	Per Impound, Per Day
In House Breed Evaluations	$22,464	Annual
Euthanasia Costs	$19.43	Per Dog
8-55 Call Related Costs	$12,480	Annual
Walk in Evaluation Costs	$7,488	Annual
Case prep Costs	$24	Per Citation
Defense Costs in Court	$3,072	Per Court Case
Average # of PBTD Impounds	136	Annual
Average In-House Breed Eval Cost	$166	Per PBTD Impound
Average 8-55 Call Cost	$92	Per PBTD Impound
Average Walk-In Eval Cost	$55	Per PBTD Impound

The ratio of PBTDs impounded to cited was calculated to be 29.5% and was then used for estimating the post 2007 years of missing PBTD citation data. 1999-2000 PBTD impounds to citations ratio was estimated at 82.6% and was then applied to the estimations for the pre-2007 years. This procedure was used because impounds data were available throughout the study period, however the citations data series were incomplete. Because citations were positively correlated with impounds, the number of impounds was used to estimate citations for missing years. It should also be mentioned that proactive measures (i.e. walk in evaluations) have significantly decreased the number of impounds over the years. Once the number of citations were estimated, the "case prep costs" were calculated for each year by multiplying the number of citations with the average case prep cost reported by DAP.

DAP reported that it incurs $3,072 for defense expenses in court on average once a year (1 case per year reported by DAP based on 2016 and 2017 data). Denver City Attorney's office reports on criminal enforcement cases from 2011-2017 supports the estimation of 1 trial/case per year. There were exactly 8 cases reported for 8-55 violations that reached trial stage from 2011-2017. Based on these data, estimated trial defense costs for DAP has amounted to almost $90K since 1989.

[24] Annual costs are assumed to be proportional to number of impounded PBTDs.

[25] DAP reported 15 minutes per animal intake (10 min per field officer, 5 min per care attendant) multiplied by DAP's reported hourly wage rate of $24.

Euthanasia Costs: Direct DAP data was obtained for the number of PBTDs euthanized each year from 2007 through 2017, and indirect DAP data for 2002-2003 and 2005-2006. The year 2004 was estimated by averaging 2003 and 2005 data and then calculating the sample average ratio of the number of PBTDs euthanized to the number of PBTDs impounded from 2002 through 2017. The weighted average of PBTD's euthanized within those years is 58.9%, while the simple average is 48.7% (SD = 15.2%). The number of euthanized PBTDs from 1989 through 2001 was estimated by applying the "weighted average" of 58.9% to the number of impounds each year. Euthanasia costs were then calculated by multiplying the number of euthanized PBTDs by the DAP reported euthanasia costs per dog.

Summary of DAP's Costs to Enforce BSL

The cost parameters for implementing BSL that were provided by DAP were used to generate an estimation of total costs over the full study period from 1989-2017 (Appendix H). The Consumer Price Index was then applied to each year of data included in the estimation in order to account for changes in price over time. The total cost of BSL was estimated to be $4.7 M in actual dollars and $5.8 M in 2017 dollars (Table 7). This amounts to $750/PBTD impounded (in 2017 $).

Table 7. Summary of DAP's Costs to Enforce BSL from 1989-2017

Variables	1989 - 2017
Estimated PBTD Impounds	7,784
Estimated PBTD Euthanasia	4588
Intake Costs	$46,705
Kennel Costs	$3,143,998
In House Breed Eval Cost	$1,290,519
8-55 Call Related Costs	$716,955
Walk in Evaluation Costs	$430,173
Euthanasia Cost	$89,154
Case Prep Costs	$96,806
Defense Costs in Court	$89,088
Total annual Costs - in 2017 Dollars	$5,814,311
Total Annual Costs - in Constant $ (CPI adjusted)	$4,687,757

Prince-George County Task Force Estimation: BSL related economic impact estimation is a very new area of research. In order to check the reasonableness of the cost figure for enforcement of BSL in the City and County of Denver, additional cost figures from other cities were sought. The only study identified that includes costs for enforcement of BSL was a task force study conducted in Prince George County, MD (PGC; Vicious Animal Legislation Task Force, 2003). A summary of the findings for Prince George County is presented in Table 8.

Table 8. PGC Task Force Estimation, 2001 - 2002

Parameter	Cost
Estimated Variable Costs of BSL Enforcement	$559,570
Estimated Fixed Costs of BSL Enforcement	$122,100
Number of PBTDs Impounded	2,031
Variable Costs Per PBTD Impounded	$215
Total Costs Per PBTD Impounded (in 2002 $)	$276
Revenues Collected (Permits, County Licenses and Bonds)	$35,061
Euthanized to Impounds Ratio	84.9%
PCG Task Force Estimated Cost Per PBTD Impound (in 2017 $)	**$378**

BSL in the City and County of Denver is estimated to cost $750/dog, while BSL in Prince George County is estimated to cost $378/dog. However, in this case, it is not statistically accurate to compare the Prince George County cost estimation to the estimation for Denver since there is only limited information regarding the methods used (data availability, time frame of data collection, sources of data, assumptions made with the analyses) for the PGC task force study. Therefore, the Prince George County figures are presented here merely as a discussion point to illustrate that one way of evaluating the effectiveness of BSL is to compare the economic impacts of the policy from jurisdiction to jurisdiction. More detailed studies on the costs of BSL in other cities are needed in order to draw conclusions regarding whether or not the costs for enforcement of BSL in the City and County of Denver are higher (or lower) than the average costs.

Impact on Surrounding Communities

BSL requires that PBTDs are removed from Denver city limits, which typically means the PBTDs impounded are either euthanized or transferred to neighboring counties. In order to minimize the euthanasia of healthy PBTDs, DAS transfers PBTDs to animal shelters in surrounding communities that do not have BSL. Since PBTDs have a statistically longer stay in shelters than other breeds of dogs, these shelters in surrounding communities who accept these PBTDs must allocate space and reserve resources to care for them. From a purely economic perspective, one could argue that the cost of transferring PBTDs from DAS to surrounding communities are “financial savings” to Denver’s local economy, as DAS would avoid shelter personnel, kenneling, and potential euthanasia costs for all PBTDs transferred out of the city. However, these transfers constitute a financial burden on the City and County of Denver’s neighbors that should be considered as a negative externality of the City and County of Denver’s BSL.

To estimate the "bad neighbor" cost of BSL, Longmont Humane Society (LHS)'s transfer intake data was analyzed with consideration for the average length of stay and cost to kennel PBTDs in their care[26,27]. LHS provided the average cost per animal's stay[28] and the average number of days a PBTD is "available" compared to an average dog for the years 2012 through 2017[29]. Next, the DAS PBTD transfer data for the years 2007 through 2017[30] was collected and analyzed (Table 9).

Table 9. Length of Stay and Cost Per Stay for Dogs in the Care of Longmont Humane Society

Variables	2010	2011	2012	2013	2014	2015	2016	2017
LOS non-PBTDs (# of days)	18	18	17	15	14	13	12	11
LOS PBTD (# of days)	N/A	50	28	N/A	39	31	N/A	N/A
Cost Per Animal Per Stay	N/A	N/A	$312	$337	$381	$402	$447	$447

To calculate the cost of all the PBTDs transferred to neighboring communities by DAS, the DAS' PBTD transfer data for the years 2007 through 2017 was analyzed and the number of PBTDs transferred from 1989 to 2017 were estimated[31]. The estimated costs of these transferred PBTDs are calculated to be over $1 M since enactment of BSL in Denver (Table 10).

Table 10. Estimated costs associated with the transfer of PBTDs out of the City and County of Denver to surrounding community's shelters.

Estimated Statistics	1989 - 2017 Total
Estimated # of PBTD Transfers to Neighbor Counties	1281
Cost of Transferred PBTDs to Neighbor Counties (in Constant $)	$728,375
Cost of Transferred PBTDs to Neighbor Counties (in 2017 $)	$1,078,816

Legal Impacts of BSL

[26] There are a number of other organizations in a number of surrounding counties that DAS transfers dogs to (and from), however LHS has been used as a single example for illustrative purposes

[27] LHS confirmed that no dogs were sent to DAS in return for accepting PBTDs, hence costs are not offset by counter transfers.

[28] LHS' cost per animal included average cost of care for both cats and dogs. Although we understand that the cost to kennel dogs in shelters are typically greater than cats, the research team elected to conservatively use the cost per animal data LHS could provide to complete the estimation.

[29] The PBTD cost per stay was adjusted proportional to the dog's length of stay. When LOS data was missing for a year, the research team assumed that the LOS was equal to the sample average of 2011-2017. For the years with missing cost of stay data, the research team discounted the available annual costs according to the CPI medical and pet services price index on a year to year basis.

[30] This data set contains transfer of PBTDs to all surrounding counties. Because DAP transfer data was only available after 2007, we estimated the 1989 - 2006 transfers.

[31] This data set contains transfer of PBTDs to all surrounding counties. The research team applied the transfer rates to the impound figures to reach the annual number of PBTD transfers from DAS to neighboring counties. Because DAS transfer data was only available after 2007, we estimated the 1989 - 2006 transfers.

The American legal system is comprised of two different types of cases, civil and criminal. Crimes are generally offenses against the state and are accordingly prosecuted by the state. Civil cases on the other hand, are typically disputes between individuals regarding the legal duties and responsibilities they owe one another. These cases are adjudicated through civil lawsuits. This section attempts to represent the amount of resources that have been deployed on criminal cases in Denver due to BSL. Since 1989, there have also been 13 BSL-related civil cases where the City & County of Denver was either the plaintiff or defendant (including *City and County of Denver v. State of Colorado*, *Colorado Dog Fanciers v. City and County of Denver*, and *Dias v. City and County of Denver*). While the economic impact of both the civil and criminal cases is out of the scope for this study and will be covered in a subsequent study, a conservative estimate of the cost of these cases given the currently known data is in the multi-millions of dollars.

Impacts of Criminal Cases

Denver Municipal Code Section 1-13 provides that any violation of the pit bull ban, codified as Section 8-55, shall be deemed a "criminal violation" and provides that any "person who shall be convicted . . . [shall] be fined in a sum not more than nine hundred ninety-nine dollars ($999.00) or imprisoned not to exceed one (1) year, or both so fined and imprisoned." So, in addition to risking the loss of one's dog, the Denver's BSL imposes municipal criminal liability on persons possessing a pit bull in violation of the city code.

In assessing the impact of the criminal cases related to the City and County of Denver's BSL (which are enforced by the City Attorney), the research team considered 157 criminal enforcement cases that occurred from 2011–2018[32]. Each criminal case was divided into one of three subgroups: (1) Cases in which a defendant pleaded guilty at his or her arraignment; (2) Cases in which the defendant had at least one hearing; and (3) Cases in which the defendant took the case to trial. As mentioned above, cases brought in state and federal court, which are typically civil cases challenging the validity of the statute itself were considered separately.

Most of the criminal cases identified for this report fell into the first subgroup which would have required a minimal amount of time in court and are thus relatively low-cost cases. In these cases, a defendant pleads guilty at his or her arraignment, the court imposes a sentence contemporaneously with the plea, and the case's time in court is complete. In the cases examined, just over 80% of the defendants in criminal cases pled guilty to their crimes when they first appeared before the judge, and nearly 66% of their cases required no additional hearings or court time.

The second subgroup accounted for just over 18% of criminal cases related to BSL that took place from 2011-2018. In twenty-nine cases, the court conducted one hearing only. In only three cases, less than 2% of the cases overall, the court conducted two hearings. These cases are by definition costlier because, regardless of whether the defendant is represented, the prosecution must prepare for the hearing. But the resulting increase in cost is likely not substantial. There are three types of hearings in these cases: (1) Bond hearings resulting from an arrest because a defendant failed to appear; (2) Motions hearings to address any motions the prosecution or defense filed relating to the case; (3) Restitution hearings to determine the amount of restitution the defendant owed as a result of his or her crime.

Bond hearings do not require an immense amount of preparation because there are predetermined considerations which determine whether a defendant presents a flight risk or is a danger to the community such that he or she should not be released on bail. In BSL cases, these considerations

[32] The city attorney reported that there were 170 criminal cases on file regarding the City and County of Denver's BSL from 2011 to 2018. The court did not have records for 2 of these 170 cases. In 11 of the 170 cases, the defendant failed to appear for court. Thus, there was no data to consider for those cases.

include, but are not limited to, whether the defendant has failed to appear before; whether the defendant has a criminal history; whether the defendant has ties to the community; and whether the defendant has any other outstanding warrants. To prepare for such a hearing, the prosecution can typically obtain all the information he or she needs from a defendant's pretrial services report.

Motions hearings can require more preparation than bond hearings. A motions hearing, though uncommon in BSL-related cases, would address any motions the prosecution or the defense filed in relation to the case. For example, if necessary, the prosecution will prepare any witnesses, respond to any motions filed, write and file motions, and be present in court for the hearing itself. These cases, in and of themselves, are not complex. They usually involve a minimal number of parties and witnesses, and the evidentiary investigation related to the crime is limited to the single incident and the dog itself. Because of the relative simplicity of these cases, it is unlikely that preparing for a motions hearing takes a substantial amount of time.

Restitution is a mechanism by which a court orders a defendant to compensate parties for the costs or damages incurred as a result of the defendant's crime. The restitution hearing is when the persons requesting restitution put forth the evidence required to substantiate their claims, and the judge weighs the statutorily-required considerations for restitution in order to decide the fair amount of restitution to impose upon the defendant. Restitution hearings require only minimal preparation because a prosecutor need only consider the victim impact statement, which outlines the costs a victim allegedly incurred as a result of the crime, to prepare for the hearing. A restitution award permits a victim to recover pecuniary losses[33] resulting from the commission of a crime[34]. Pecuniary losses are monetary expenses a person suffers because of a crime. In the cases collected from the last seven years in Denver, the court awarded restitution in less than 5% of all cases. Restitution is typically awarded to cover medical expenses or veterinarian costs associated with dog attacks or bites. To receive this restitution, victims need to present the bill associated with their injuries. Despite only being awarded in seven cases, restitution amounted to nearly $18,000 in costs paid to the victims. Restitution was available in at least seven additional cases, but it was either not sought by the victim or not awarded by the court. However, this means that in nearly 9% of cases, a private individual is bearing the up-front costs associated with a violation of the BSL. And then in half of those cases, the court compensated the individual for his or her respective pecuniary losses.

The third subgroup only covers cases that went to trial. This group includes eight cases, which is approximately 5% of all cases. Interestingly, none of the cases set for trial actually proceeded to trial. In every case where the defendant appeared for trial, the defendant pled guilty at, or just prior to, trial.[35] The court files did not provide any information regarding why these defendants plead guilty rather than proceeding to trial. Despite the fact that these cases did not actually proceed to trial, there are costs associated with being set for trial. When a case is set for trial, the court summons jurors to sit for that trial. If the defendant pleads guilty just before trial, the jurors have been summoned to court to be impaneled for that trial. However, the cost to the public is limited to the cost of summoning and organizing the jurors, which is usually done by a single clerk. Under Colorado law, a person's employer is responsible for compensating him or her when called for jury duty.[36] Thus, the time the jurors are

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[33] A "pecuniary loss" is a loss suffered by a victim and "includes but is not limited to all out-of-pocket expenses, interest, loss of use of money, anticipated future expenses, rewards paid by victims, money advanced by law enforcement agencies, money advanced by a governmental agency for a service animal, adjustment expenses, and other losses or injuries proximately caused by an offender's conduct and that can be reasonably calculated and recompensed in money." But this does "not include damages for physical or mental pain and suffering, loss of consortium, loss of enjoyment of life, loss of future earnings, or punitive damages." COLO. REV. STAT. § 18-1.3-602(3) (2017).

[34] *Id*. §§ 18-1.3-602(3), -603.

[35] One defendant failed to appear at trial, so he never entered a plea.

[36] *See* COLO. REV. STAT. § 13-71-126.

serving is not a direct cost to the public, but jury duty — even for cases that do not go to trial — removes those individuals from the workforce for that day.

Considering the criminal enforcement cases as a whole, the majority of these defendants did not have representation. In fact, only 13 of the 152[37] defendants retained or requested representation. This means nearly 86% of the defendants waived their right to request representation. Five of the 13 defendants - over 38% of defendants who retained or requested counsel – did so when he or she failed to appear in court, was subsequently arrested on a warrant, and then had an in-custody hearing. But when a defendant is represented, it is far more likely that the case will be set for trial. In nearly 85% of the cases that were set for trial, the defendant retained or was appointed representation. But, as indicated in the previous paragraph, the phrase "set for trial" does not indicate that the cases were actually tried. When a case is tried, both sides present their respective evidence, and the judge or jury renders a decision based on the evidence. None of the defendants who retained representation actually had their case tried – they all pled guilty at trial. Retaining representation did not lead to a high number of objectively more favorable outcomes for defendants. Nine of the 13 defendants – over 69% of the defendants with representation – pled guilty to the charges against them. The difference between these defendants and the defendants in "group one" (who pled guilty at their first appearance in front of the judge) is that represented defendants typically pled guilty much later in the case. For example, three of them pled guilty just before their respective jury trial, and two of them pled guilty at their fourth appearance before the judge. Only 3 of the 13 defendants – just over 23% – had the charges against them dismissed. One was the result of a plea deal on another case, and one charge was dismissed by the prosecution prior to trial. One defendant obtained a "deferred judgment," which meant that his case could be dismissed if he satisfied the conditions of receiving a deferred sentence.

When a public defender represents a defendant, it is an additional cost to the public[38]. Only five of the 157 case filed – 3% of the cases considered – indicate a public defender was involved in the case. The Denver Office of the Municipal Public Defender, a publicly-funded organization, represents indigent defendants who face jail time for violating municipal ordinances in Denver County Court. An individual is indigent when (1) his or her annual income is equal to or less than $15,175 and has liquid assets of $1,500 or less; or (2) his or her annual income is less than $18,906.25; his or her assets total $1,500 or less; and his or her expenses are equal to or exceed annual income.[39] In these cases, the public is funding both the prosecution and defense.

The 2011 - 2017 criminal case data (collected via open public requests) was used in order to estimate the number of PBTD citations that led to more costly formal legal procedures. From 2011-2017, 166 of the 285 PBTD citations (58%) proceeded to legal procedures. To get an estimate of the legal impacts of BSL over the full study period, this rate of 58% was then applied to the 5,042 PBTD citations identified over the full study period of 1989-2017. Of the 5,042 PBTD citations from 1989-2017, 2,935 would be expected to have resulted in legal procedures. This represents a significant investment of legal resources to manage the criminal cases resulting from BSL.

Impact of Civil Cases

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[37] Within the 157 cases, five defendants had two cases against them. Thus, though there are 157 cases, there are only 152 defendants.

[38] An indigent defendant has a constitutional right to appointed counsel when, if he or she is convicted of a crime, it could result in imprisonment. See *Lassiter v. Dep't of Soc. Servs.*, 452 U.S. 18, 27 (1981); see also *Stern v. Cty. Ct.*, 773 P.2d 1074 (Colo. 1989) (holding that an attorney must be provided for an indigent defendant when the proceeding could result in imprisonment). However, a defendant must qualify as indigent to obtain representation through the public defender's office.

[39] The Colorado Supreme Court issues guidelines to determine when an individual is "indigent." *See* Chief Justice Directive 98-01 (August 2011). The income levels listed are based on an unmarried individual with no dependents. The qualifying income level is dependent on the number of people in the household.

Based on an open records request, the Denver City Attorney's office produced records regarding six civil cases since 1989 related to the BSL. Four of these cases were filed in state court, and two were filed in federal court. Two of the four state cases proceeded to the Colorado Supreme Court, the state's highest court; one case was appealed to the Colorado Court of Appeals, the state's intermediate appellate court; and one case was heard only at the Denver District Court, the state's trial court. Both federal cases were appealed to the U.S. Court of Appeals for the 10th Circuit (see Appendix I for more detail). The cost of these civil cases is far more variable than the criminal cases examined in the prior section. These cases spanned over months or years, and some likely cost hundreds of thousands of dollars. To determine how much these cases "cost" the public, the amount of time the attorneys and the judiciary spent on them would have to be evaluated. These calculations were beyond the scope of this study. While a portion of these costs could be estimated using the available court records, the majority of the time spent in litigation strategy and discovery are either undocumented or missing and therefore cannot be estimated reliably given the lack of data. The research team plans to conduct a subsequent study that focuses on the economic costs of these civil cases.

Conclusions and Proposed Alternatives

There have been substantial economic impacts of BSL on the City and County of Denver. The city has lost an estimated $3.7 million/year in grooming, boarding, and medical care-related services, for a total of $107 million since the legislation was enacted in 1989. Enforcement of BSL has cost the city's animal protection agency, DAP, an additional estimated $5.8 million throughout the study period. Additionally, it is estimated that the transfer of PBTDs to surrounding communities has resulted in a cost of $1 million since 1989 for shelters operated by the City and County of Denver's neighbor cities. While a specific estimation of costs related to the legal proceedings related to BSL was beyond the scope of this study, 2,935 (58%) of the 5,042 PBTD citations from 1989-2017 would be expected to have resulted in criminal legal procedures, which represents a substantial additional cost to the Denver community beyond what was already calculated.

For these costs, the City and County of Denver has accrued questionable improvements in public safety across a number of relevant metrics. A minority (24.6%) of Denver residents say BSL make them feel safer. These individuals' perception that PBTDs are dangerous is likely the primary driving force behind continuing the enforcement of BSL. Meanwhile, the overall trend in dog bites in Denver has decreased since 1989. This decrease has been driven by reductions in bites by all breeds. Therefore, improved, breed-specific data collection on dog bites and other measures of animal-driven public safety concerns are needed to objectively assess how removing PBTDs from communities is impacting the actual safety of residents.

BSL appears to disproportionately affect individuals in underserved communities. Only 19.0% of Denver residents stated that they had been impacted by BSL. BSL has negative implications for individuals in the U.S. who keep PBTDs and, therefore, the impacts should be well-documented and weighed against the potential benefits of the policy. If BSL is disproportionately impacting only specific individuals in a community, policymakers may want to consider alternative solutions such as increasing the accessibility of pet supportive services for that population, rather than targeting them with punitive action. By measuring the impacts of enforcement of BSL in these communities, this report provides an opportunity to critically evaluate the effectiveness of the policy in achieving its intended outcomes, such as improving the health and safety of all the human and non-human animals of a community.

Other cities have come to the conclusion that BSL may not be worth the investment. A number of communities have overturned their BSL following review of the impacts of the policy. Two of Denver's neighboring cities, Castle Rock and Fort Lupton, overturned their BSL in May of 2018 and February of 2019, respectively, following thorough assessment and community discussion. A package of integrated

dangerous dog legislation that focuses on owner responsibility as opposed to breed was enacted as a replacement for Castle Rock's BSL (Appendix A). After 25 years, the Dutch government removed a ban on PBTDs because it was ineffective at reducing the number dog bites in their country (Kaspersson, 2008). A study in Belgium found that the breeds restricted under their BSL were not responsible for a majority of the reported dog bites (Keuster, Lamoureux & Kahn, 2006). Another study found that over a thirteen-year study period in Odense, Denmark there continued to be dog bites reported to emergency rooms despite the presence of BSL provisions requiring restricted breeds to wear muzzles in public (Todd, 2019). More rigorous research is needed to see exactly what types of dogs are biting in Colorado to determine if BSL has effectively contributed to a reduction in the rate of dog bites.

BSL is only one of the potential interventions that exists to reduce dog bite incidents. Education regarding dog bites is viewed by some as a more effective preventive platform for community safety (AVMA, 2001). One study showed that by incorporating community-specific strategies in addition to prevention at the family level, efforts to address dog bites were more effective (Morrongiello et al., 2013, AVMA Task Force on Canine Aggression and Human-Canine interactions, 2011). Other studies have shown that educating the public on dog bite prevention and acknowledging that many breeds can exhibit dangerous behavior if not properly socialized and cared for can help reduce shelter overpopulation, redirect tax dollars to more effective public safety programs, and can help fund spay and neuter programs for underserved communities (Franklin, 2013). Ray (2011) suggests the strategy of integrating age appropriate humane education materials into schools related to animal bites and zoonotic diseases. More evidence is needed to understand how targeted, community-based policies can reduce dog bite injuries.

There are a number of professional organizations who have taken a stance on BSL and proposed alternative solutions to the presence of dangerous dogs in a community. In their position statement on BSL, the American Veterinary Society of Animal Behavior states: "BSL is ineffective and can lead to a false sense of community safety as well as welfare concerns for dogs identified (often incorrectly) as belonging to specific breeds," (AVSAB, 2014). The American Society for the Prevention of Cruelty to Animals (ASPCA) supports a community-based approach to resolving the reckless guardian/dangerous dog question whereby all stakeholders—animal control, animal shelters, medical and veterinary professionals, civic groups, teachers, public officials—collectively identify an appropriate dog bite prevention strategy. Central to this model is an "advisory council or task force representing a wide spectrum of community concerns and perspectives" whose members review available dog bite data, current laws, and "sources of ineffectiveness" and recommend realistic and enforceable policy (ASPCA, 2018). An example of Calgary's "model ordinance" that would be an alternative to BSL is summarized in Appendix J.

In identifying solutions and alternatives to BSL, it is important to acknowledge the variety of stakeholders who are invested in a policy. Clifton (2002) provides an important perspective, however: "People who love animals tend to measure the success of animal control programs and humane societies by the number of animals their shelters kill or "save" through rehoming. But the rest of the public may take an opposite view. Nearly half the population of the U.S. have neither dogs nor cats. What these people tend to care about is whether someone responds promptly and effectively to their complaints about animal damage, animals at large, feces on lawns or sidewalks, dangerous dog behavior, and—perhaps most of all—dogs barking long into the night or very early in the morning," (Clifton, 2002). In this way, it is important to acknowledge that different stakeholders will weigh the importance of some impacts over others. In order to generate holistic, sustainable policy, however, a Humane Community will take efforts to balance those impacts in the interest of preserving the health of the human and animal residents of a community.

Colorado consistently receives a high rating on lists of dog-friendly states (Wenzel 2016), and Denver is home to some of the nation's most innovative animal welfare organizations that have helped

the state achieve one of the highest live release rates from its animal shelters in the US (Hawes, et al. 2019). Therefore, the existence of BSL – a breed ban that costs the city millions of dollars to implement and defend with inconclusive public safety outcomes – is inconsistent with Denver's image as a leading animal welfare innovator. The existence of more effective alternatives further highlights this inconsistency. While the quality of the dog bite, animal sheltering and economic data across the entirety of the Denver legislation's existence make definite conclusions difficult, the overall findings support thorough reassessment of the legislation with an emphasis on identifying more successful and cost-effective alternatives. This would continue Denver's progress toward becoming a truly Humane Community.

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Conflicts of Interest

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APPENDICES

Appendix A: Castle Rock, CO BSL - Summary of Repeal

In May 2018, the city council of Castle Rock, CO, a city 30 miles south of Denver, voted 5-0 to repeal its 26-year-old BSL. Castle Rock will now use a system regulating dogs on their behavior, not breed, by classifying them as dangerous or potentially dangerous. At the time of repeal it was reported that there had been 600 dog bites in Castle Rock over the last ten years, with only 20 bites involving a pit bull type dog. 21 of the 600 dog bites were classified as severe, but none of the severe bites had involved a pit bull type dog. Castle Rock cited the following reasons in its repeal of BSL for more comprehensive dangerous dog policies:

- Considerable growth in human and pet population
- Difficulties in enforcement, including time, costs, and resources devoted to impounding and prosecuting dogs who have not committed any harm
- Challenges attendant to BSL such as reliable breed identification
- Concern that BSL will lead residents to not license their dogs or seek appropriate veterinary care

The revised ordinance, which went into effect June 1, 2018, reads "No dogs are restricted based on their appearance. Restrictions are now based on dog behavior and are identified in a two-tiered system defining potentially dangerous dogs, and dangerous dogs. A dog need not bite to be determined as potentially dangerous. A potentially dangerous dog may be allowed to remain in the Town under court ordered restrictions. A dog determined to be a dangerous dog is not allowed in the Town." [40] Under the new system, dogs that are determined to be dangerous would be placed under the first tier. Animals with this designation would be removed from town limits or euthanized. The second tier would be for potentially dangerous dogs. These are dogs that have injured a person or domestic animal, but the injury was not serious. These potentially dangerous dogs would need to be registered with the city, and the owners would need to obtain a permit for them. The revised ordinance is designed to hold the owners responsible for the actions of their dogs, allowing for court-mandated preventative measures to make sure the dog's behavior does not escalate. It also provides an opportunity for rehabilitation, letting the court mandate education, retraining classes, and higher fencing.[41]

[40] https://www.crgov.com/2977/Animal-Ordinance-Updates

[41] https://www.westword.com/news/castle-rock-pit-bull-ban-ends-advocates-want-to-stop-slaughter-in-denver-10268960

Appendix B: Denver Animal Protection Intake and Outcome Data

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
RETURNED ADOPTION	0	0	0	0	0	11	0	1	82	89	87
CONFISCATED	549	533	466	409	374	413	448	437	456	438	413
OWNER SURRENDER	927	952	850	625	735	748	779	477	392	394	456
STRAY	2,945	2,817	2,609	2,695	2,923	3,246	3,937	3,846	3,877	3,843	3,476
TRANSFER IN	0	0	0	10	30	13	26	196	64	20	77
Total Intake	4,421	4,302	3,925	3,739	4,062	4,431	5,190	4,957	4,871	4,784	4,509
ADOPTION	1,000	1,151	1,034	966	1,048	1,193	1,657	1,653	1,323	1,092	1,121
RTO	1,420	1,518	1,427	1,272	1,402	1,635	1,870	1,909	2,043	2,199	2,125
TRANSFER	486	475	613	729	951	957	1,173	926	674	517	565
EUTHANASIA	1,448	1,124	831	737	631	614	458	482	793	919	681
MISSING	8	3	8	5	2	2	4	3	1	0	0
DIED	24	22	10	16	8	11	11	20	14	10	13
Total Outcomes	4,386	4,293	3,923	3,725	4,042	4,412	5,173	4,993	4,848	4,737	4,505
Asilomar LRR (%)	66.26	73.24	78.36	79.65	84.14	85.79	90.86	89.89	83.33	80.39	84.59
ASPCA LRR (%)	65.73	73.08	78.32	79.35	83.73	85.42	90.56	90.54	82.94	79.60	84.52

Appendix C: 8-55 Complaint Calls by Zip Code

Zip Code	# of Complaint Calls
80219	69
80204	54
80239	44
80223	38
80212	37
80205	35
80249	34
80211	33
80207	32
80235	23
80224	21
80220	20
80209	16
80222	15
80231	13
80206	12

80221	12
80237	8
80123	7
80236	5
80246	5
80210	4
80216	4
80218	4
80202	3
80230	3
80203	2
80247	2
80238	1

Appendix D: Petkeeping Rate Estimations

	U.S.	CO	Denver
1986	38.2	45.3	43.3
1987	37.9	44.9	42.9
1988	37.5	44.5	42.5
1989	37.2	44.1	42.1
1990	36.8	43.7	41.7
1991	36.5	43.3	41.3
1992	30.7	36.4	34.8
1993	30.1	35.7	34.1
1994	29.4	34.9	33.3
1995	30.5	36.2	34.6
1996	31.6	38.1	36.4
1997	32.8	38.8	37.1
1998	33.9	40.2	38.4
1999	34.3	40.7	38.9
2000	34.7	41.2	39.3
2001	36.1	43.7	41.7
2002	33.7	40.0	38.2
2003	34.9	41.4	39.5
2004	36.1	42.8	40.9
2005	36.7	43.5	41.5
2006	37.2	43.3	41.4
2007	37.5	44.5	42.5
2008	37.9	44.9	42.9
2009	38.2	45.2	43.2
2010	38.4	45.6	43.5
2011	36.5	42.5	40.6
2012	38.8	46.0	43.9
2013	37.7	44.6	42.6
2014	36.5	43.3	41.4
2015	37.6	44.4	42.4
2016	37.4	44.2	42.2
2017	37.6	44.5	42.5

Appendix E: Comparison of Colorado vs. U.S. Dog Ownership Rates (at the household level)

Colorado vs. U.S. Dog Ownership			
	CO	US	CO / US Ratio
1986 (est.)	45.3	38.2	1.19
1991 (est.)	43.3	36.5	1.19
1996	38.1	31.6	1.21
2001	43.7	36.1	1.21
2006	43.3	37.2	1.16
2011	42.5	36.5	1.16
Average 1996 - 2011	**42.7**	**36.0**	**1.19**

Appendix F: Approach 1 - Lost Expenditures due to BSL

Lost Expenditures	Total 1989 - 2017	Annual Average
Number of Households in Denver	7,146,669	247,270
Percentage of CO Households with Dogs	n/a	42.0%
Number of Dogs in Denver		166,967
Number of PBTD in Denver		7,311
Lost Local Spending - Medical (in 2017 $)	$55,411,754	$1,910,750
Lost Local Spending - Other Pet Services (in 2017 $)	$86,872,453	$2,995,602
CPI Growth % (Pet Services + Medical)	n/a	4.23%
CPI Growth % (Pet Services)		3.02%
CPI Adjusted Lost Local Spending - Medical (in Constant $)	$38,671,630	$1,333,504
CPI Adjusted Lost Local Spending - Other Pet Services (in Constant $)	$65,310,056	$2,252,071
Total Lost Local Expenditures Medical, Boarding and Pet Sitting (in 2017 $)	**$142,284,207**	**$4,906,352**
Total Lost Local Expenditures Medical, Boarding and Pet Sitting (in Constant $)	**$103,981,686**	**$3,585,575**

Appendix G: Approach 2 - Denver PBTD Related Lost Sales Estimation (using CBP data)

Location	2012 NAICS code	Year	Number of establishments	Annual payroll ($1,000)	Est. Sales Total	PBTD Related Total Est. Sales
Denver County, Colorado	Veterinary services	2016	42	23,635	$61,310,739	$1,826,079
Denver County, Colorado	Pet care (except veterinary) services	2016	65	10,707	$24,630,111	$733,583
Denver County, Colorado	**All Relevant Sectors**	**2016**	**107**	**34,342**	**$85,940,851**	**$2,559,662**

Appendix H: Full Dataset for Estimation of DAP's Costs to Enforce BSL.

Variables	1989 - 2006	2007 - 2017	1989 - 2017
Estimated PBTD Impounds	5,630	2,154	7,784
Estimated PBTD Euthanasia	3,575	1,013	4,588
Intake Costs	$33,781	$12,924	$46,705
Kennel Costs	$2,310,748	$833,250	$3,143,998
In House Breed Eval Cost	$933,416	$357,103	$1,290,519
8-55 Call Related Costs	$518,564	$198,391	$716,955
Walk in Evaluation Costs	$311,139	$119,034	$430,173
Euthanasia Cost	$69,471	$19,683	$89,154
Case Prep Costs	$84,598	$86,590	$96,806
Defense Costs in Court	$55,296	$55,296	$89,088
Total annual Costs - in 2017 Dollars	$4,177,120	$1,540,384	$5,814,311
Total Annual Costs - in Constant $ (CPI adjusted)	$3,241,866	$1,445,891	$4,687,757

Appendix I: Details of BSL-Related Civil Cases

In *Dias v. City & County of Denver*, three women, presumably residents of the City & County of Denver (the "City"), challenged the constitutionality of the BSL and sought prospective injunctive relief against the enforcement of the law against them. Plaintiffs claimed that the BSL violates the 14th Amendment in two ways. First, Plaintiffs made a facial challenge to the law by claiming it to be unconstitutionally vague on its face. Under the void-for-vagueness doctrine, there are two ways in which a law can be impermissibly vague: the law can fail "to provide people of ordinary intelligence a reasonable opportunity to understand what conduct it prohibits"; or it can authorize, or even encourage, arbitrary and discriminatory enforcement."[42] Here, Plaintiffs claimed the BSL's "ban on dogs that have 'the majority of physical traits' of one of the enumerated prohibited dogs fails to [sic] provide dog owners with fair warning of which dogs are covered by the ban."[43] Second, Plaintiffs made an as-applied challenge that the BSL deprives them of procedural due process. The 14th Amendment prohibits states from depriving a person of property without "due process of law." To determine the amount of "due process" that a particular situation requires, a court engages in a balancing test that considers the private interests of the affected individual, the interests of the government, and the risk of the erroneous deprivation of property under the current procedures. Plaintiffs claim that the fact that BSL permits seizure of the dogs without a prior hearing violated their procedural due process right. They also claim the City's unwritten policy of "summarily executing dogs whose owners have previously been cited under the [BSL]; coercing waivers of due process protections and the privilege against self-incrimination; and using the coerced, self-incriminating statements to encourage guilty pleas and/or discourage jury trials" violated procedural due process.[44]

Procedurally, this case moved between the U.S. District Court for the District of Colorado and the U.S. Court of Appeals for the 10th Circuit. The case, as all cases do, started when Plaintiffs filed their complaint in the trial court: the U.S. District Court for the District of Colorado. Defendants responded by filing a motion to dismiss.[45] While waiting on the judge to rule on the motion to dismiss, Plaintiffs proceeded to file a Motion to Certify Class. The motion is not dispositive, but it indicates the Plaintiffs' intent to expand the case to include all persons similarly affected by the BSL. A class-action lawsuit can have wide-reaching and costly effects on a city if successful. The district court granted defendant's motion to dismiss, and Plaintiffs appealed the ruling to the Tenth Circuit.

The filings required to present a case to an appellate court are generally far simpler than the filings required for a trial court. In a federal appellate court, the appellant (the party appealing the case) files an opening brief; the appellee files an answer brief; and the appellant may, but is not required to, file a reply brief to answer the claims in the appellee's brief. The court may, at its discretion, schedule the case for oral argument. The preparation required for oral argument is comparable to researching a filing a dispositive motion, and it is reflected as such in the case analysis. The parties in this case filed all three briefs and argued the case before the Tenth Circuit. The Tenth Circuit affirmed the dismissal in part, reversed in part, and dismissed in part. As a result, the case was remanded back to the District Court for further proceedings consistent with the Tenth Circuit's ruling. Once back at the trial court, the Defendants again filed a dispositive motion, a motion for summary judgment.

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[42] *Hill v. Colo.*, 530 U.S. 703, 732 (2000).

[43] *Dias v. City & Cty. of Denver, Colo.*, No. 07-cv-00722-WDM-MJW, 2008 WL 791939, at *7 (D. Colo. Mar. 20, 2008), *affirmed in part, reversed in part, dismissed in part*, 567 F.3d 1169 (10th Cir. 2009).

[44] *Dias v. City & Cty. of Denver, Colo.*, 2008 WL 791939, at *1 (D. Colo. Mar. 20, 2008), *affirmed in part, reversed in part, dismissed in part*, 567 F.3d 1169 (10th Cir. 2009). [should just be *Id*. at *1.]

[45] A "motion to dismiss" is a dispositive motion. If a defendant's motion to dismiss is successful, the entire case is dismissed.

Appendix J: Calgary Model Ordinance

In 2006, Calgary, AB passed the Responsible Pet Ownership Bylaw (23M2006). Under the bylaw, both cat and dog owners are responsible for licensing their pets at three months of age and for ensuring the pets remain on the owner's property. Cats are not allowed to roam and must be restricted to their owner's property. When off their owner's property, dogs must be under their owner's control. All areas in Calgary are on-leash except for off-leash areas that are designated by signs.

The Responsible Pet Ownership Bylaw makes it possible for Animal & Bylaw Services to:

- Impound cats and dogs roaming or at large in the community, in violation of the bylaw. This is for the protection and safety of pets and the public
- Feed, shelter and provide veterinary care for the cats and dogs impounded and under Animal & Bylaw Services' protection and care at the Animal Services Centre
- Adopt out cats and dogs that have not been claimed by their owners after a wait period as set out by the Responsible Pet Ownership Bylaw[46]

Animal & Bylaw Services does not advocate limiting the number of pets or breed specific legislation because it is thought that poor animal behavior results from a failed relationship between pet and owner. Therefore, Animal & Bylaw Services advocates responsible pet ownership based on the following five principles[47]:

- License and provide permanent identification for pets
- Spay or neuter pets
- Provide training, physical care, socialization and medical attention for companion pets
- Do not allow pets to become a threat or nuisance in the community
- Procure pets ethically and from a credible source

Under the Responsible Pet Ownership Bylaw, at three months of age all cats and dogs residing in the City of Calgary must have a City of Calgary license. To ensure a high licensing rate, Calgary imposes a $250 penalty for failure to license a dog over three months of age[48] . Licensing fees, not tax dollars, fund the entire $5m animal services budget[49], including the following programs and services[50]:

- Reunite lost cats and lost dogs with their owners
- Operate the Pet Drive Home program
- Educate cat and dog owners about responsible pet ownership
- Enforce the Responsible Pet Ownership Bylaw
- Shelter and feed lost impounded cats and impounded dogs in our vet-operated facility
- Manage the City of Calgary's animal adoption program
- Deliver public education programs
- Run the City of Calgary's volunteer animal socialization program
- Help Calgarians resolve their animal related conflicts
- Provide funding to veterinary clinics for emergency medical care for injured stray cats and dogs
- Operate the No Cost Spay/Neuter program for the cats and dogs of eligible Calgarians
- Provide medical care to adoptable cats and dogs in the City of Calgary's state of the art clinic

[46] http://www.calgary.ca/CSPS/ABS/Pages/Animal-Services/Responsible-pet-ownership-bylaw.aspx

[47] Ibid

[48] https://www.aspca.org/about-us/aspca-policy-and-position-statements/position-statement-breed-specific-legislation

[49] https://montrealgazette.com/news/local-news/how-calgary-reduced-dog-attacks-without-banning-pit-bulls

[50] https://www.aspca.org/about-us/aspca-policy-and-position-statements/position-statement-breed-specific-legislation

Calgary has some of the strictest animal regulations in North America. In addition to $250 fines for unlicensed animals (several times the cost of a license), owners of dogs involved in an attack can be fined up to $10,000 and the dogs may be euthanized. The main complaints against dog owners are lack of proper care, excessive noise and smells. Calgary has 24 animal control officers who patrol the city, investigate complaints and pick up stray or lost animals. For dogs involved in an aggressive incident, be it as simple as a dog that chased someone in a threatening manner, the officers investigate the complaint, perform mediation and figure out a solution, which sometimes requires the animal receive training from an expert. In 98% of cases, the nuisance order on a dog is lifted after owners fix the problem. In Calgary, 90% of dogs are licensed. In 2011, 87% of lost dogs were returned to their owners, 8% were adopted, and 5% had to be euthanized. The city shelter, which holds 84 dogs, is usually half empty[51].

In 1985, Calgary recorded just over 2,000 aggressive dog incidents. In 2014, the city had 641 confirmed reports of aggression incidents, with 252 dog bites, despite a large upsurge over that period in the city's human and pet population. The numbers of bites saw a marked rise starting in 2013, but officials say that was due to a campaign asking residents to report all forms of bites, including in-house bites that were not previously calculated, through 311 reporting hotline. According to numbers released by officials in Calgary, there were 243 bites reported in 2015, a jump from 2013, when there were 198[52]. Herding dogs, such as shelties, Australian shepherds and collies, were responsible for the most bites in Calgary in 2015, being involved in 25% of incidents. They were followed by terriers, which include American Staffordshires and Jack Russells, at 23%. Sporting dogs, such as retrievers, pointers and spaniels, were third at 18%[53].

Data shows that restricting breed ownership has not reduced the incidence of dog bites in Canada. A survey of reported dog bite rates in 36 Canadian municipalities found no difference between jurisdictions with BSL and those without. Likewise, a 2010 Toronto Humane Society survey found no change in dog bites in Ontario in the years before and after Ontario's BSL. Calgary, however, saw a five-fold reduction over 20 years – from 10 bites per 10,000 people in 1986 to two in 2006[54]. Calgary has reduced reported incidents of aggression by 56% and its bite incidents by 21% by requiring guardians of dogs who have displayed aggression to dogs or to humans to pay fines ranging from $250 to $1500[55].

[51] https://montrealgazette.com/news/local-news/how-calgary-reduced-dog-attacks-without-banning-pit-bulls

[52] https://www.cbc.ca/news/canada/calgary/pitbull-ban-quebec-montreal-1.3656166

[53] https://www.cbc.ca/news/canada/calgary/pitbull-ban-quebec-montreal-1.3656166

[54] https://www.torontohumanesociety.com/pdfs/Breed_Specific_Legislation_Jan-14.pdf

[55] https://www.aspca.org/about-us/aspca-policy-and-position-statements/position-statement-breed-specific-legislation