

PRESCRIBED GOAT GRAZING IN URBAN SETTINGS: A PILOT STUDY OF THE LEGAL FRAMEWORK IN NINE U.S. CITIES

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1 ABSTRACT

This paper provides a preliminary assessment of how municipal codes affect prescribed grazing efforts in U.S. cities. Throughout the U.S., landscape architects, planners, and other land management professionals are experimenting with the use of goats and sheep as biological agents for controlling invasive plants and assisting in the restoration of ecological function in woodland and riparian environments—a land management technique known as prescribed grazing. Recent experiments in public settings such as park systems and airports have spurred interest in this practice, and generated growing market demand for prescribed grazing services on private lands. In responding to this demand, however, land planners and prescribed grazing contractors enter a legally ambiguous terrain. To assess how municipal ordinances may affect the use of prescribed grazing as a method for managing invasive vegetation, the authors conducted a literature review and a review of land-use regulations in nine U.S. communities where prescribed grazing activities are underway. Among these municipalities, few regulations currently are in place to allow and effectively govern prescribed grazing on privately-owned urban lands. Consequently, many prescribed grazing efforts in these cities may be illegal or only quasi-legal—a situation that may limit further testing of prescribed grazing methods while also potentially placing animals, humans, and the environment in jeopardy. The paper concludes with suggestions for how public policy-makers, planners, environmental contractors, and landscape architects may collaborate on research and environmental remediation via prescribed grazing, and how existing codes might be altered to support this emerging frontier of urban land management.

1.1 Keywords

goats, law, land management, livestock, prescribed grazing

2 INTRODUCTION

2.1 Prescribed Grazing as a Landscape Management Technique

In cities throughout North America, landscape architects, planners, and other land management professionals are experimenting with the use of goats and sheep to control invasive plants and assist in restoring ecological function in woodland and riparian environments. This land management technique, known as “prescribed grazing” or “targeted grazing,” is defined as “the application of a specific kind of livestock at a determined season, duration, and intensity to accomplish defined vegetation or landscape goals” (Launchbaugh and Walker, 2006, p.3). In the past, prescribed grazing was used primarily to reduce wildfire risk or control weed species in rangelands (e.g., Martin and Huss, 1981; Tsiouvaras *et al.*, 1989). Recently, however, land management professionals in the U.S. and abroad have become interested in using the technique to manage vegetation in urban settings—a trend that has received publicity via media coverage of prescribed grazing in public landscapes such as parks and airports. For example, Boulder, Colorado’s parks and recreation department has used 300 goats to manage vegetation in the Boulder Reservoir (Schlaufman, 2010). Similarly, goats and sheep have been used in Atlanta to remove invasive plants from future parkland and to manage vegetation at Hartsfield-Jackson International Airport (Massara, 2012; Wheatley, 2010). Goats have also been employed at Chicago’s O’Hare Airport and to clear land for construction on the University of Wisconsin-Madison’s campus (Green, 2011; Sfondeles, 2012). Recently, prescribed grazing has achieved notoriety through media coverage of “eco-mowing” experiments in Paris, France (Beardsley, 2013). If city officials are satisfied with the results, ruminants may soon be seen grazing amidst some of the world’s most iconic urban landscapes.

In line with such publicity, demand for prescribed grazing services has grown within the private sector. Goat and sheep farmers have begun renting their animals to property owners for land clearing purposes, and in a number of U.S. cities entrepreneurs have founded businesses that specialize in providing prescribed grazing services (e.g., Livestock for Landscapes, 2012). Landscape architects also have participated in this trend. Indeed, depending on the particular circumstances and needs of the project, prescribed grazing may prove to be a viable method for land clearing or vegetation management in urban landscapes (Beatty, 2005; Landscape Architecture Magazine, 2005).

Public and professional interest in prescribed grazing is partially fuelled by a perception that the technique represents a more “natural,” low-impact alternative to conventional vegetation control methods that rely on mechanical equipment or chemical herbicides (e.g., Beatty, 2005; Manning and Miller, 2011). Unlike gas-powered chainsaws, “brush hogs,” and “weed-whackers,” goats and sheep do not consume fossil fuels or generate acute noise pollution, and they may present less risk to human and environmental health than chemical herbicides. Due to their relatively small size and weight, goats and sheep are easy to handle and transport. At the same time, goats and sheep are well adapted to ranging over steep and rugged terrain that would be inaccessible to humans with mechanical equipment (Hart, 2001; Manning and Miller, 2011). In comparison to cattle, goats and sheep include a higher proportion of browse in their diets, making them especially useful for removing woody invasive species (e.g., Hart, 2001; Pcischel, 2006). If managed appropriately, prescribed grazing may prove to be an effective and cost-efficient means of controlling invasive non-native vegetation and improving ecological function in urban green infrastructure systems, as well as a strategy for turning weeds into a saleable final product (livestock) (e.g., Kleppel and Girard, 2011; Launchbaugh and Walker, 2006).

2.2 Legal Status of Prescribed Grazing in U.S. Cities

In many U.S. communities, the legal framework governing domestic livestock was developed decades ago, and it reflects a view of animal husbandry and other agriculture-related activities within urban settings as “nuisance” land uses (Henry, 2006). In communities that have enacted land use zoning ordinances, livestock grazing typically is allowed only in areas that are specifically zoned for agriculture. By using prescribed grazing to manage vegetation in non-agricultural zones, property owners and contractors subject themselves to adverse legal action by disgruntled neighbors or enforcement by the municipality against quasi-legal or illegal urban animal husbandry. This risk may dissuade property owners and contractors from experimenting with prescribed grazing on private land, or compel them to undertake such efforts illicitly. Neither of these outcomes is conducive to increasing our understanding of the possible ecological, economic, and social merits of prescribed grazing in urban contexts.

Consequently, the uncertain legal status of prescribed grazing may limit the extent to which the technique can be considered a viable management option for landscape designers, planners, and managers.

2.3 Prescribed Grazing in Athens, Georgia: A Case in Point

The issues mentioned above were highlighted in a prescribed grazing initiative recently launched at the University of Georgia campus in Athens-Clarke County, Georgia. Entitled the “Tanyard Creek Chew Crew,” the effort was conceived as a pilot study to test the effectiveness, management requirements, and community engagement potential of using goats to remove invasive vegetation in a heavily urbanized setting. Since spring 2012 the Chew Crew project has engaged local goat and sheep farmers, student volunteers, university faculty and staff, local children, campus facilities management personnel, and local contractors in an effort to improve the aesthetic quality and ecological function of a wooded stream corridor. Local goat and sheep farmers expressed interest in the prospect of providing prescribed grazing services outside of the Tanyard Creek project area; however, these farmers were hesitant to enter the market—and private land owners were hesitant to hire them—due to the uncertain legal status of prescribed grazing in the community. Later conversations with Athens-Clarke County officials proved their hesitance was well-founded, as prescribed grazing practices were deemed to be illegal in any zoning district other than agricultural zones. This discovery led the authors to question how municipal regulations might affect the development of prescribed grazing as an urban land management tool.

2.4 Purpose of the Current Pilot Study

The current study, an outgrowth of the Tanyard Creek Chew Crew initiative, is intended to provide a preliminary survey of how municipal codes may affect prescribed grazing efforts in U.S. cities. It is not intended to offer a comprehensive, scientific assessment of the full range of regulatory issues that may exist with respect to prescribed grazing in U.S. municipalities. Rather, as a pilot study, the current effort is a small-scale investigation focused on building a preliminary understanding of the issues that may be relevant when considering the legality of urban prescribed grazing. The limited scope of the investigation is consistent with pilot studies, which generally aim to refine a research question, test a research protocol, identify logistical problems, collect preliminary data, and estimate the variability in data and outcomes (Baker, 1998). As the pilot study developed, the goals became three-fold: (1) determine generally how existing municipal regulations may affect the practice of prescribed grazing in urban settings within the United States; (2) determine what regulations may be necessary to protect the health, safety, welfare, and morals of the community, and to support continued experimentation and use of this potentially useful land management technique; and (3) begin conceptualizing a process for establishing beneficial and effective regulations.

3 METHODS

3.1 Multiple-case Study Approach

According to the U.S. Census Bureau (2007) approximately 36,000 non-county, municipal or township governments exist in the United States. Since a comprehensive review of every municipal code was beyond the scope of feasibility, the authors elected to complete a thorough review of a small sample of the total set of possible cases. A multiple-case study approach was adopted, since the authors were interested in obtaining an overview of the regulatory issues that may pertain to prescribed grazing, rather than producing results that would be generalizable to all U.S. communities. Such macro-level analysis involving multiple cases is a common strategy in political science research (Swanborn, 2010, p.22). Thomas (2011, p.513) notes that cases studies in social science research typically focus on “persons, events, decisions, periods, projects, policies, institutions, or other systems,” and that individual “cases” may be defined as “an instance of a class of phenomena that provides an analytical frame—an object—within which the study is conducted and which the case illuminates and explicates.” Yin (2009, p.9-12) states that case studies are best equipped to address questions of “how” and “why,” and they are well-suited to describing contemporary events. Accordingly, with respect to the relationship between municipal regulations and prescribed grazing practices, the authors elected to examine a small number of municipal ordinances in order to describe how and why these practices are currently governed.

3.2 Selection of Cases

In selecting cases for analysis the authors employed an information-oriented sampling approach rather than random sampling—*i.e.*, cases were selected on the basis of known information, rather than via random selection from among the more than 36,000 possible cases. The authors employed two case selection strategies: opportunity sampling, and cluster sampling (Cochran, 1977). Opportunity sampling (sometimes also known as accidental, grab, or convenience sampling) occurs when a study set is obtained from data that is close at hand. In this case, the municipal code of Athens-Clarke County, Georgia, constituted the initial data of the opportunity sample. Conversations with local planning and code enforcement officials yielded an additional set of data from four municipalities that Athens-Clarke County officials view as model or “aspirational” communities. These were Bloomington, Indiana; Boulder, Colorado; Chapel Hill, North Carolina; and Madison, Wisconsin. All of the communities in the opportunity sample are medium-sized cities, with populations ranging from 233,209 (Madison) to 57,233 (Chapel Hill) (U.S. Census Bureau, 2010). All four cities also are home to major public research universities.

Four additional cities were added to the study set via a cluster sampling technique that utilized data obtained from the Internet. Cluster sampling involves selecting from a population wherein individuals have been grouped or clustered according to some common criterion or criteria. Since the pilot study sought to uncover the range of strategies that municipalities currently employ to regulate the use of livestock for prescribed grazing, the authors sought to target U.S. cities where private citizens were known to be engaged in these activities. Thus, the existence of an “active prescribed-grazing community” became the primary variable by which the authors sought to cluster municipalities.

The authors utilized the Google Search engine and Google Trends to gauge citizen interest in prescribed grazing in metropolitan areas and cities across the United States. Publicly-accessible, aggregate Google search engine data has recently been employed in a number of social research fields ranging from political science (*e.g.*, Reilly *et al.*, 2012) and economics (*e.g.*, Goel *et al.*, 2010) to epidemiology (*e.g.*, McCarthy, 2012). As a further measure of public interest in the topic, the authors researched Facebook posts related to urban livestock and prescribed grazing experiments. As with Google Search data, social scientists are increasingly analyzing Facebook and other social media outlets as sources for popular discourse about politics and other topics (*e.g.*, Williams and Gulati, 2013). With respect to the present study, the authors’ approach assumed that cities with active prescribed grazing initiatives would be prominently represented in Facebook posts and Google Search traffic. The authors compiled a rank-order list of U.S. cities with the highest volumes of Internet traffic about the topic of urban prescribed grazing, as measured via Google Trends and Facebook posts. The four highest-ranked cities were selected for inclusion in the pilot study: Atlanta, Georgia; Charlottesville, Virginia; Oakland, California; and Seattle, Washington. When added to the municipalities identified through opportunity sampling, the total study set included nine municipalities that ranged in population from approximately 43,000 (Charlottesville) to 609,000 (Seattle) (U.S. Census Bureau, 2010). Although the findings of this study should be regarded as preliminary and suggestive, it is hoped that they will prove useful in developing a more systematic and comprehensive analysis of municipal codes, as well as more thorough consideration of the regulatory issues associated with prescribed grazing

3.3 Keyword and Content Analysis Using Municode

After determining the cases to be examined, the authors analyzed the ordinances of the nine targeted cities to determine whether or how they addressed practices related to prescribed grazing. To do this, the authors located the online version of each city’s municipal ordinances either via the city’s official website or via Municode, an online publishing service that updates and maintains municipal codes (Municipal Code Corporation, 2013). Within each code, keyword searches were performed using the terms “livestock,” “goat,” “sheep,” and “grazing.” These searches generally returned results that allowed the authors to determine whether and how the municipality regulates the keeping of small livestock on private lands. In this way, the authors found all references to such animals within the city’s code, and then traced all of those references through the relevant ordinances in order to determine the degree to which prescribed grazing practices would be subject to municipal approval and regulation.

4 FINDINGS

4.1 The Illegal Landscape of Prescribed Grazing

The land management practice of prescribed grazing is not explicitly addressed in any of the municipal codes examined through this pilot study. The municipal code analyses further suggested that many instances of prescribed grazing on privately-owned, non-agricultural lands may be illegal within the nine case-study cities. Some of the cities have adopted ordinances that explicitly permit citizens to keep goats on city property as pets, however, and others have codes that do not explicitly prohibit urban goat-herding, thus casting the practice into a quasi-legal gray area. The nine municipalities of the pilot study may be grouped into three general categories: (1) cities that explicitly allow residents to keep a small number of goats as domestic pets; (2) cities that tacitly allow urban goat-keeping (*i.e.*, the municipal code does not explicitly prohibit livestock such as goats); and (3) cities that explicitly prohibit urban goat-keeping. Although municipalities in the first category have made it possible for goats to be considered part of the urban landscape, none explicitly allows prescribed grazing as a land-management tool.

4.2 Cities that Explicitly Allow Urban Goat-keeping

Keyword searches within the municipal codes of Seattle, Charlottesville, and Boulder led directory to regulations that explicitly address conditions under which residents may keep one or more goats on privately-owned property. In each city, ordinances permitting “backyard goats” were recently enacted in response to citizens’ interest in keeping goats as pets or as sources of home-produced milk or meat. The regulations governing backyard goats included the following requirements: neutering of males, dehorning, maximum size limit, stocking rate limit, minimum setback requirement, and license fees. Only Seattle’s ordinance encompassed all of these, however all of the ordinances included a stocking rate limit. Stocking rate is the maximum number of goats allowed on a parcel, usually expressed as the number of goats per unit of land area. Seattle’s limit begins at three goats per lot, but increases to four goats once a lot is at least 20,000 square feet in size, with an additional goat allowed for each additional 5,000 square feet (Seattle Municipal Code (SMC), 23.42.052(A)). Similarly, Charlottesville places an across-the-board limit of three goats per lot (Charlottesville City Code, Ch. 4, Sec. 4-9).

4.3 Cities that Tacitly Allow Urban Goat-keeping

The municipal codes of both Oakland and Atlanta include regulations that imply that urban goat-keeping is allowed, along with other regulations that seem to imply the opposite. For example, the Oakland code explicitly bans goats from apartments, hotels, and business districts (Municipal Code Corporation 2013f, 6.04.290), yet elsewhere the building code requires that structures used to house or raise goats must be impervious to the ingress of insects and rodents (Municipal Code Corporation 2013f, 15.08.230). Beyond these two sections and three others dealing with meat and dairy standards and prohibiting animals from public parks, the Oakland ordinances do not specifically address issues related to goats. Despite this regulatory ambiguity—or perhaps because of it—Oakland has a vibrant urban goat-herding scene (Esch, 2010; Richards, 2010).

4.4 Cities that Explicitly Prohibit Urban Goat-keeping

In cities that do not allow urban goat-keeping, such as Athens-Clarke County, Bloomington, and Madison, goats are included within the definition of “livestock.” The codes treat the keeping and raising of livestock as an “agricultural use,” which is permitted only on land zoned for agricultural uses, or within the largest of the residential zones. Such parcels are generally few in number and tend to be located near the outskirts of the municipal boundary. This restriction acts as a major impediment to prescribed grazing implementation, as most cities explicitly do not allow agricultural uses in areas not zoned for such use, even under special use permits.

5 DISCUSSION

5.1 Grazing Landscapes in Limbo

Although most instances of prescribed grazing in the nine case-study cities are probably illegal, or quasi-legal at best, contemporary Internet data and news media suggest that such activities are underway in each of these communities. From conducting preliminary interviews with some individuals involved in prescribed grazing activities, the authors have learned that such work often occurs illicitly, or with the tacit

approval of neighbors and city officials who choose to turn a blind eye to relevant code violations. Although a few cities, such as Boulder, Charlottesville and Seattle, have enacted legislation that is more permissive of livestock in urban environments, the resulting ordinances do not necessarily facilitate prescribed grazing. On the contrary, municipal codes designed to allow backyard goats may actually complicate attempts to implement prescribed grazing. This is because backyard goat-keeping and prescribed grazing, while both forms of animal husbandry, involve fundamentally different relationships among humans, animals, and the environment. Some of the restrictions placed upon backyard goat owners in an effort to protect the health and safety of animals and the community would compromise the feasibility of a prescribed grazing program on the same property. As a result, prescribed grazing initiatives may be most “legal” in communities where livestock such as goats hold a legally ambiguous status, such as Atlanta and Oakland. Even in these communities, however, it is questionable whether the uncertain legal status of prescribed grazing is a desirable state of affairs, or whether it provides the best environment in which to advance our knowledge about this land management tool.

5.2 Urban Backyard Goat-keeping Versus Prescribed Grazing

Maintaining goats as backyard pets or as sources of milk or meat is fundamentally different from employing such animals as part of a land management regimen. Backyard goat-keeping is conceived as a long-lasting arrangement between animals, their human caregivers, and a particular parcel of land. Regulations that backyard goats are intended to minimize the impact of long-term animal husbandry on the environment and the surrounding community. Hence, residents are generally allowed to keep only a small number of goats on their property, and they may be required to observe minimum setbacks for the placement of goat shelters. The animals themselves must be dehorned, and male goats must be neutered. Additionally, backyard animals may be limited in size (e.g., less than 100 pounds in weight). In contrast, prescribed grazing involves placing goats or sheep on a property for shorter periods of time. Most prescribed grazing regimens are enacted over two or more growing seasons, but the system does not entail maintaining a herd on the same parcel of land continually and indefinitely as in a typical pasturage arrangement. Similarly, the fencing, shelter, and other structures needed to ensure the health and safety of the animals are likely to be of a more temporary nature. Moreover, in order to achieve the desired impacts on vegetation, many prescribed grazing programs would require higher stocking rates and larger animals than would be permitted under backyard goat-keeping allowances that currently exist cities such as Seattle or Charlottesville. The existing backyard goat-keeping provisions in these cities do call attention to some of the issues that should be addressed in any effort to govern prescribed grazing practices in urban settings, however. These are highlighted below.

5.3 Backyard Goat-keeping Regulations That Are Compatible with Prescribed Grazing

The backyard goat regulations of Seattle, Boulder and Charlottesville include some requirements that would likely prove applicable in a prescribed grazing framework, such as regulations requiring neutering and dehorning. In an urban setting it is very important to neuter male goats, as adult male goats can emit a formidable odor and exhibit other behaviors that may prove troublesome or offensive to neighbors. Additionally, neutering will effectively eliminate concerns about feral goat populations becoming established as feral cats have in many cities. Dehorning, although perhaps more controversial, can protect the safety of both goats and humans. Inquisitive horned goats sometimes get their heads stuck in tight places, particularly in fences. Dehorning significantly reduces this hazard, while also eliminating the danger that horns may pose to humans who are unaccustomed to handling goats (MacKenzie and Goodwin 1993).

5.4 Backyard Goat-keeping Regulations That May Interfere with Prescribed Grazing

Both Seattle and Charlottesville set a maximum size for goats kept within the city. While small animals may be well-suited to living comfortably in close quarters, even well-known backyard goat advocates such as Jennie Grant contend that the current size limit, 100 pounds, is too small (Grant, 2012, p.43). The issue of size limits may be even more problematic with respect prescribed grazing programs. Small breeds may be less useful as defoliators; larger animals may be expected to consume larger quantities of vegetation and prove better capable of navigating difficult terrain. Similarly, setback requirements that make sense in a backyard context may act as obstacles to efficient prescribed grazing

practices. While it may be perfectly reasonable to prohibit owners from constructing permanent goat structures or enclosures immediately adjacent to a neighbor's residence, much of the value of prescribed grazing stems from its flexibility as a land-management tool. Often in grazing a particularly difficult property there are few viable spots for providing adequate shelter for the animals. If these areas are within the setback range, the setbacks may effectively prohibit prescribed grazing as a land management option despite the temporary nature of these housing structures. More limiting still are setback requirements that affect goat enclosures in addition to housing structures. In the case of small parcels, these setback requirements could leave much of the property unavailable to grazing. Seattle's goat licensing fee raises a final concern. If operators must pay an annual fee of \$20 per goat within the city, this could inflate the costs of a prescribed grazing regimen to a level that makes the practice less competitive with mechanical or herbicide techniques.

5.5 Backyard Goat-keeping Regulations That Conflict with Prescribed Grazing

A necessary aspect of all backyard goat-keeping regulations is limitation of the number of goats allowed on a particular property. Of the three cities in this study that allow backyard goats, each takes a different approach to regulating stocking rates. Charlottesville imposes a flat maximum number of animals per property. Boulder ties the number of permitted goats to the parcel size: one goat per half-acre of lot size. Seattle has adopted a hybrid of these two approaches: the city permits an initial maximum of three small animals per parcel, but allows for up to four animals per 20,000 square-feet and one additional animal for every 5,000 square feet beyond 20,000 square feet. Seattle's framework is slightly complicated by the inclusion of multiple species of animals in these numbers, forcing property owners to choose from among goats, cats, dogs, and pot-bellied pigs. Restrictions such as these may be appropriate in a backyard context, wherein too many animals in a small lot could easily lead to environmental degradation and risks to both human and animal health. However, they may present challenges to the effective operation of a prescribed grazing program, wherein the chief objective is to carefully control the grazing activity of goats or sheep in order to defoliate unwanted plants. Thus, a stocking rate limit that may be ideal for long-term backyard goat husbandry may effectively render prescribed grazing impractical.

5.6 The Case for Regulation

In the United States, the chief argument in favor of regulating prescribed grazing, as with any human activity that is fairly subject to civic approbation, rests on a government's responsibility to protect the health, safety, and welfare of its citizens. In the case of prescribed grazing, regulation must be conceived and implemented to ensure the health and safety of humans, animals, land, and water. Additionally, prescribed grazing regulations should effectively consider and limit harm from noise, smell, escaped animals, and increased traffic. Absent or improper regulation of prescribed grazing could lead to a host of problems, including the spread of disease to humans, noise and odor nuisances, and injury or property damage caused by escaped animals. On some sites, excessive stocking rates could cause soil erosion, or impair surface water quality. The animals themselves may suffer from overcrowding, disease, malnutrition or dehydration, exposure to inclement weather, death or injury from predators, and the uncontrolled spread of feral populations. Just as municipal regulations commonly seek to mitigate these issues for the millions of dogs and cats that Americans keep as pets, communities could likewise develop policies and standards to safeguard the well-being of the animals that are employed in urban prescribed grazing services. Aside from direct consequences to the community, property owners and service-providers currently may be at risk from adverse legal action against quasi-legal or illegal prescribed grazing projects—a condition that could suppress the growth of prescribed grazing as a form of ecological restoration and land management. By adopting regulations that govern the use of small ruminants as a land-management tool, a community may allow citizens to realize the potential economic and ecological benefits of this vegetation management technique, open a new environmental service sector for local entrepreneurs, and exercise some control over where, when, and how the practice is implemented.

6 MEANS OF REGULATION

The inclusion of goats within the definition of agricultural use is ubiquitous among cities that prohibit urban goat-keeping. This restriction impedes prescribed grazing implementation. In order to get beyond this, the definition of agriculture may need to be revised, which could require the revision of the

entire zoning ordinance. Alternatively, a special exception could be instituted that allows goats or sheep to be used outside agricultural zones in a prescribed grazing context, thus avoiding revision of the zoning ordinance. Aside from these changes, however, other code modifications would be required to permit and effectively govern prescribed grazing practices. A community's approach to regulation could take different forms, depending on the community's needs and its capacity for code administration and enforcement. In the case of prescribed grazing, the major options presented are: (1) legalization with general requirements (*i.e.*, general regulation); (2) a permitting system with requirements tailored to each project; or (3) a licensing system, possibly in coordination with a third-party licensing organization.

6.1 General Regulation

A general regulation strategy would entail an ordinance that explicitly allows prescribed grazing within the urban areas of the city as long as certain requirements are met. Boulder's ordinance allowing urban goat-keeping is an example of a general regulation. It allows goats to be kept within the city with only one limit: at least one-half acre of land per goat. The foremost benefit of legalization with only general requirements is that the governing entity is minimally involved in each individual site, and thus minimizes administration and enforcement costs. In instances where the regulations are likely to be followed, and the consequences of not following them are either minimal or readily apparent (and thus amenable to quick response on the part of enforcement officials), a general regulation may be adequate. This strategy may be sufficient for many communities, although some municipalities—for reasons relating to unique environmental, social, or political conditions—may prefer one of the other two options.

6.2 Permitting System

A permitting system would allow property owners to stock their land with greater numbers of larger goats or sheep than would be allowed under typical backyard goat-keeping standards. However, animals would be allowed to remain on a parcel only for short periods of time, and only on land specified through the permitting process. Such a process could work similar to construction permitting, although the process may be more streamlined. If the government is allowed to determine requirements on a case-by-case basis, it will be better able to adapt its regulations to the unique circumstances of each prescribed grazing project. For example, if the usual setback requirement for goat enclosures is 20 feet, but a project would be infeasible unless the setback requirements is reduced to 15 feet, a government may be able to determine whether it could allow the smaller setback without compromising the intent of the regulation. Alternatively, the government could require the contractor to meet stricter requirements in other areas of the project in order to compensate for the setback-reduction. A permitting system would give municipalities greater flexibility and control over prescribed grazing practices within the city, but at increased cost to the government: in order to issue a permit, administrators must invest time and effort in judging whether a proposed project meets the required standards. In order to mitigate this cost, many special use permits include a fee that must be paid by the applicant. This fee would effectively increase the cost of each prescribed grazing project, if only by a small amount.

6.3 Licensing System

A third strategy for regulating prescribed grazing in urban areas is to create a system that educates and certifies citizens to be licensed prescribed grazing operators. Similar to a permitting system, a licensing procedure would afford the government more control over prescribed grazing practices, although implementing such a system would require a similar investment of time and funds. In a licensing scenario, the governing entity would establish requirements that project coordinators must meet. Once those requirements are met, the government issues a license to the coordinator. These licenses would be required in order to enact a prescribed grazing project. By requiring documentation to be displayed on-site, the municipality may hold the licensed party accountable for any problems that may arise, while the government is assured that an experienced and qualified individual is responsible for managing any unique circumstances that may pertain to the prescribed grazing operation.

7 DATA REQUIRED TO EFFECTIVELY REGULATE PRESCRIBED GRAZING

As a land management technique, prescribed grazing is still in an experimental phase. Much remains to be learned about how to effectively utilize goats and sheep to eliminate or control unwanted

vegetation, and the application of prescribed grazing practices to urban environments foregrounds additional unknowns. Further research is needed in order to allow property owners and contractors to determine stocking rates and the duration and frequency of treatments required to achieve management goals. In addition, more information is needed regarding the kinds of supervision, fencing, shelter, setbacks, supplemental food and water, pet-interaction issues, escape management, and surveillance and monitoring that may be necessary in urban settings. Additional study also may be needed with respect to the municipal costs associated with regulation, the costs and benefits of licensing fees, third-party certification options, and capacity development in support industries such as veterinary services.

In establishing baseline minimums for factors like fencing and stocking rates, a municipality must ensure that the limits adequately protect public health, safety, and welfare, and also justify the specific limits set by the regulations. Unfortunately, no entity has yet compiled best-practices standards for prescribed grazing in urban settings. Resources exist for determining minimum shelter requirements and fencing heights because this information is needed by all goat- and sheep-herding enterprises, whether they occur within a quarter-acre city lot or a sprawling ranch. There is no compilation of maximum stocking rates for non-pasture lands, however. Effective and appropriate stocking rates will likely vary between different regions of the country. Even within an individual city, two parcels of the same size could have different carrying capacities based on vegetation type, foliage density, soil, slope, terrain features, and water quality and availability. Moreover, the carrying capacity of a single site will likely vary during the course of a prescribed grazing treatment in response to changes caused by weather. Depending on species composition and other factors, grazed vegetation may rebound at varying rates, requiring different grazing recurrence intervals. In sum, municipalities may not be able to effectively regulate stocking rates for prescribed grazing in the manner used by cities to govern backyard goat-keeping. The factors that determine whether a prescribed grazing treatment can achieve the desired management goals while safeguarding environmental quality and animal health are too numerous and variable to be accommodated by a simple rule establishing a maximum number of animals per unit of land. Most likely, determinations about acceptable stocking rates and grazing regimens will need to be made on a case-by-case basis—a situation that, particularly in communities where environmental quality and health issues are of high concern, might favor a regulation strategy based on permitting or licensing.

This is not to say that beneficial prescribed grazing regulations could not be written in the absence of perfect and complete data. For example, setback requirements do not rely on detailed information related to factors such as appropriate stocking rates, but are informed by the aesthetic requirements of the community and other health and safety regulations. Moreover, while all of the issues mentioned above may factor into determining the success of an urban prescribed grazing effort, a municipality may not need to address each of them directly. For example, a governing entity may determine that it does not need to require access to water for goats or sheep involved in prescribed grazing because it is in contractors' best interest to ensure their animals' health. Regarding issues such as fencing, a municipality may choose to grant significant discretion to property owners and contractors, aside from requiring that fencing used for prescribed grazing projects meet a minimum height requirement. After the private sector takes up prescribed grazing the market may also help ensure that it is carried out efficiently within the bounds set by the regulations. Nonetheless, our knowledge of best practices is likely to increase only in step with expanded experimentation with prescribed grazing. Herein exist opportunities for collaboration among municipalities, property owner, private contractors, and research institutions.

8 EXPANDING THE LEGAL LANDSCAPE OF PRESCRIBED GRAZING: AN AGENDA FOR RESEARCH AND COLLABORATION

The data required to develop effectively regulate prescribed grazing can be obtained only if grazing experiments continue, and the resulting data is collected, analyzed, and disseminated to municipal officials, contractors, planners, landscape architects, and citizens who may be interested in using this technique to remove invasive exotic vegetation from their properties. Continued experimentation and monitoring of the results of prescribed grazing programs are needed in order to devise methods for determining appropriate stocking rates and other environmental management parameters. Data related to these factors may be available from two general sources: (1) prescribed grazing efforts implemented by contractors and other land managers; and (2) grazing experiments conducted by research institutions for the purpose of generating new knowledge about best practices.

8.1 The Role of Private-sector Practitioners and Public-sector Land Managers

Although many prescribed grazing efforts on privately-owned urban lands may be technically legal or quasi-legal, these activities nonetheless are underway and they are generating potentially valuable knowledge. In addition, some of the most extensive urban prescribed grazing experiments have occurred on public lands such as parks, college campuses, and airports—settings that may be less subject to the strictures of the local zoning code and where grazing can proceed under the watchful eye of government administrators. The farmers, contractors, and other land management professionals who have been involved in these efforts thus represent significant, untapped sources of practical knowledge and experience. Knowledge obtained from such professionals is likely to be both general (e.g., the herding behaviors and care requirements of goats and sheep) as well as local (e.g., the distinct environmental and social factors that exist in a particular site, community, or region). This knowledge would benefit efforts to create model legislation for prescribed grazing. Prescribed grazing projects such as those undertaken at O’Hare International Airport or within the park systems of Boulder, Charlottesville, and Atlanta, already represent a form of public/private collaboration. By supporting continued government-sponsored experimentation on public lands, a municipality may retain control of the experiment, while also allowing government employees to gain experience that would be needed to enforce future prescribed grazing regulations on private property.

8.2 The Role of Research Institutions

If ongoing and already completed initiatives represent a potential source of information about urban prescribed grazing best practices, who will collect this data and make it usable for property owners, land managers, and public-policy makers? Private business owners and government officials are unlikely to have the time and resources to devote to this public service. Moreover, it is not clear that individual business-owners or municipal governments would be best equipped to disseminate this knowledge to the array of individuals and institutions who may be interested in the technique. However, such a role would seem to fit well within the mission of research and education institutions—particularly the public “land grant” universities that exist in all U.S. states. Most state land-grant universities include academic programs in agriculture and animal husbandry, environmental sciences, law and public policy, and environmental planning and design—disciplines that converge in the practice of prescribed grazing. Moreover, these institutions typically support cooperative extension services that facilitate education of citizens and policy-makers, as well as networking among urban and rural entrepreneurs. All of these features suggest that land-grant institutions are particularly well-situated to play an important role in advancing potentially beneficial land management practices such as prescribed grazing.

Aside from collecting and synthesizing knowledge that already has been acquired through prescribed grazing experiments in urban areas, public universities could advance research of best practices by establishing controlled prescribed grazing experiments on public land. Such efforts would introduce goats and sheep to the community in a prescribed-grazing context, while also functioning as a means to gather scientific evidence about best practices. An example of this is the Chew Crew pilot study on the campus of the University of Georgia. In Georgia, as in many states, state property is not subject to local zoning regulations. This exemption allows experimentation to occur in the kinds of urban areas where prescribed grazing normally would not be allowed. Furthermore, by situating research sites in such settings, prescribed grazing experiments may become educational resources for faculty and students in fields such as urban ecology, agriculture, and landscape architecture—experts and future professionals who may wish to work with prescribed grazing in the future.

8.3 Options for Disseminating Prescribed Grazing Data

For knowledge generated through prescribed-grazing research to effectively influence community-level regulation, it must be shared among those who are interested in using this land-management technique. Currently, there is no central clearinghouse for information about urban prescribed grazing. The University of Idaho maintains an online resource for information about prescribed grazing, although much of it focuses on rangeland management issues (University of Idaho, Rangeland Center, 2012). Similarly, Kathy Voth, a rancher and livestock consultant based in Loveland, Colorado, maintains a website that is an excellent source of information on prescribed grazing (Livestock for Landscapes, 2013). Both of these resources suggest how centralized information clearinghouses might play an important role

in gathering and disseminating information about urban prescribed grazing, including study results, best practices, and model legislation. As noted above, since some of the variables affecting best practices are likely to be region-specific, regional information centers may prove to be more effective than a single national clearinghouse. Once again, these conditions suggest that the cooperative extension systems or other outreach programs that exist in many state land-grant institutions may be logical candidates for fulfilling this role. Moreover, if a significant number of communities adopt a licensing approach to regulating prescribed grazing, an existing cooperative extension service might be a viable vehicle for providing the training and certification that would be required of prospective contractors.

9 CONCLUSION

The current municipal codes of the nine communities selected for this pilot study either prohibit prescribed grazing on most urban lands, or grant it only quasi-legal status. None of the communities have regulatory frameworks in place that specifically permit prescribed grazing or govern the practice in order to ensure its effectiveness and to protect the health and safety of the animals and the community. Some cities, such as Atlanta and Oakland, tacitly allow grazing in certain urban areas. Other cities have enacted ordinances that specify conditions under which residents may keep a small number of goats on their properties. While the regulatory frameworks of cities address aspects of small livestock husbandry that are relevant to prescribed grazing, the ordinances themselves would need to be extensively modified in order to permit and effectively govern prescribed grazing as a land management practice. There are three options for such changes: general regulation, permitting, and licensing. In order for any of these to be effective, however, further data is needed about best-practices and safe limits for prescribed grazing. The data could come from private actors as well as from studies led by research institutions. Once the database is created, it must be collected, compiled, and disseminated by a clearinghouse, which may either be a public or private institution. The database may in turn be used to develop model legislation and support the burgeoning field of prescribed grazing in the United States.

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