

COMMUNITY ATTITUDES CONCERNING URBAN DEER
POPULATION MANAGEMENT
THESIS

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by

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I. INTRODUCTION

The Texas Hill Country is home to one of the world's highest densities of white-tailed deer (*Odocoileus virginianus*). The high populations of deer in the region are a novelty for many visitors and new home seekers from all over the world. However, the deer have become so abundant in the region that some signs point to a possible overabundance.

This research centers on the City of San Marcos, Texas, located on the south-eastern edge of the Edwards Plateau, in the Texas "Hill Country." The city straddles the Balcones Escarpment, the boundary between the Hill Country and the Coastal Plains. The south-eastern portion of the city is built on the Blackland Prairies, an eco-region defined by its rolling grasslands and agriculture. The northwestern portion of San Marcos is nestled into the Hill Country, comprised of rocky limestone hills, ash juniper, oaks, cacti, and a diverse collection of understory brush.

Problem

White-tailed deer populate and thrive in residential areas of the north-western portion of San Marcos. As opposed to natural fluctuations of forage availability in nature, urban landscapes provide year round watered and fertilized food for deer (Creacy 2006). In many urban and suburban areas similar to San Marcos deer reproduce in great numbers, maintaining high fawn survival rates, and living full lives

due to habitat suitability and lack of natural predators. Although many residents enjoy the aesthetic aspect of viewing deer in their neighborhoods, others regard urban deer as nuisances. Lyme disease, deer-vehicle collisions, damage to ornamental landscaping and native vegetation, and other damages to human health and property are all problems caused by an overabundance of urban deer.

To date, no large-scale deer census has been conducted in San Marcos, thus, it is still not clear if a biological carrying capacity has been exceeded. However, residents and officials observe many diseased deer, a good indication of deer overpopulation (Stratemann 2009). According to many residents, the local social carrying capacity might have been reached years ago. Deer-car collisions and landscape destruction are common within the city limits. In the year 2008 alone, the city received over 162 phone calls requesting field euthanasia for deer struck by vehicles. More than 250 hours of police labor were required for this task alone, costing the city a significant amount of money (Stratemann 2009). In addition, many residents complain about damage to ornamental landscapes and gardens, costing some people thousands of dollars. While corn feeders may be seen in yards of residents who enjoy the presence of deer, others are forced to erect fencing around gardens and ornamental landscaping. San Marcos currently has no ordinance that addresses the feeding of deer. In 2009, a handful of residents submitted a petition to the City of San Marcos Parks and Recreation Department, requesting that two-thirds of the deer population be removed immediately (Stratemann 2009). Management solutions for these types of problems are rarely agreed upon with ease. Residents often have

different attitudes, expectations, and tolerance levels regarding urban deer and management options.

Purpose

The objective of this study is to better understand and describe the attitudes of San Marcos residents regarding local urban deer. In particular, this study attempted to identify residents' perceptions of deer overabundance and urban deer management and determine if there is consensus among residents. Results from surveyed San Marcos residents were used to examine possible relationships between resident's location and interactions with deer and their attitudes toward the deer and urban deer management. A quantitative approach was used to analyze any possible relationships between variables. Open-ended "Additional Comments" were used for qualitative support to explore and help better understand respondents' attitudes and concerns which were not addressed in the survey.

II. REVIEW OF THE LITERATURE

Urban Deer

Throughout North American history, humans and white-tailed deer (*Odocoileus virginianus*) have had a variety of interactions. Deer have been hunted for thousands of years, but only in the past few hundred years have humans had such a great impact on deer in America. For instance, by the late 19th century, white-tailed deer populations had been reduced to the point that they could not be found in many places. In Texas, the white-tailed deer almost disappeared completely due to over-harvesting and the destruction of their environment (TPWD 2006). However, by the 20th century, humans understood their role in the endangerment of the white-tailed deer. Measures to rectify the deer habitat resulted in their recovery across the country. This was accomplished by establishing harvest limits, hunting seasons, and game law enforcement agencies. Texas in particular now has the largest white-tailed deer population in the country (TPWD 2006).

White-tailed deer have adapted and now thrive alongside humans in urban areas. Year-round watered and fertilized food and screening are provided for deer in urban and suburban areas. These landscapes are often better deer habitats than undeveloped land (Henderson et al. 2000; Lauber and Knuth 2004). Urban areas provide a mosaic of habitats, providing ideal conditions for deer (Henderson et al. 2000). Urban deer have smaller home ranges than deer in agricultural or forest areas

due to abundance of food, water, and screening (Kilpatrick and Spohr 2000). Urban landscapes have also become important foraging sites for deer during winter and droughts (Kilpatrick and Spohr 2000). Although many urban-suburban residents enjoy seeing wildlife in residential areas (Connelly et al. 1987; Decker and Gavin 1987; Cornicelli et al. 1993), negative experiences associated with an overabundance of deer are increasing public concerns in many communities (McAninch 1995). Managing urban deer has now become very problematic in many areas because hunting-based deer management strategies may not be feasible or socially acceptable in many urban communities (Messmer 2003).

There are a variety of problems associated with urban deer and human interactions, causing deer to be perceived by many as hazards and nuisances. Urban deer pose high deer-vehicle collision risks (Hansen and Beringer 1997; Henderson et al. 2000). Deer-vehicle collisions have increased significantly in the United States since 1980 (Romin and Bissonette 1996; Sullivan and Messmer 2003). There are on average about 1.5 million deer-vehicle collisions in America per year, causing over \$2 billion in damage to vehicles each year, over 200 human fatalities (Nielsen et al. 2003; Rondeau and Conrad 2003) and over 29,000 injuries (Sullivan and Messmer 2003). This is a costly problem to both citizens and local and state governments. In 1993, the average repair cost for vehicles involved in deer-vehicle collisions was almost \$2,000 (Sullivan and Messmer 2003). Most state deer-vehicle collision records are based on the number of dead deer found on the side of the road. These figures do not include the deer that get hit and wander far from the road to die, so the actual numbers are far higher than reported (Sullivan and Messmer 2003). More than

90 percent of deer involved in deer-vehicle collisions die from their injuries (Sullivan and Messmer 2003). According to the Insurance Institute of Highway Safety, good national statistics on deer-vehicle collision trends do not exist (IIHS 1993). "Vehicle-accident reporting systems might account for only 15-20% of actual deer-vehicle collisions and thus tend to underestimate the magnitude of the problem" (Sullivan and Messmer 2003, 169).

The Insurance Institute for Highway Safety (IIHS) says the state's abundant wildlife and additional traffic have made Texas the most hazardous state for deer-vehicle collisions every year since 2000. Texas has had a 33 percent increase in deer-vehicle collisions from 2004 to 2009 (State Farm Insurance 2009). Texas also leads all other states in motorists who have been killed in deer-vehicle collisions (Insurance Journal 2006). Urban landscapes in particular possess unique characteristics that can lead to higher deer-vehicle collision numbers such as higher densities of humans and deer, many roads, and habitat interspersed (Nielsen et al. 2003). This destructive interaction between humans and deer has caused many to view white-tailed deer as a hazard.

Another hazard posed to humans by urban deer is the transmission of tick-borne diseases such as Lyme disease (Curtis and Hauber 1997; Henderson et al. 2000). Studies have shown that the number of cases of Lyme disease directly correlate with deer densities in communities. More deer means more ticks that may carry disease (Connelly et al. 1987; Hansen and Beringer 1997). Therefore, when deer herd sizes decline, so do Lyme disease cases (Kilpatrick and LaBonte 2003).

This hazard is prevalent in many communities in the eastern United States, but few cases are reported in Texas (TPWD 2006).

Many people view urban deer as a nuisance. Damage to landscape vegetation is usually the top complaint in communities with high urban deer densities (Connelly et al. 1987; Curtis and Hauber 1997; Henderson et al. 2000). Humans often invest significant amounts of money into landscaping their yards. Even more is spent on replacing ornamental shrubs after destruction by urban deer. Thus, a result of urban deer grazing is often large amounts of money and labor hours spent on protecting landscaping from urban deer.

Over-abundant deer populations also affect habitat quality in public parks and nature preserves (Curtis and Hauber 1997). When deer become overabundant, they are known to over-browse underbrush and seedlings creating alternate stable states for forest vegetation and affecting local plant and animal diversity (Meshea and Rappole 1997; Schmitz and Sinclair 1997; Stromayer and Warren 1997). In many studies, deer appeared to be the driving force in seedling recruitment (Tilghman 1989; Meshea and Rappole 1997). For instance, the rarity of oak saplings in the savannas and woodlands of the Eastern Edwards Plateau of Texas has been linked to intense browsing pressures by white-tailed deer (Russell and Fowler 1999). Thus, there are just too many deer in the Hill Country for oak trees of all species to grow to adult size classes.

Identifying Urban Deer Problems

There are a number of ways for a community to determine whether there is an overabundance of white-tailed deer, and to what extent the deer are actually causing

problems. Traditional census counts are able to accurately measure deer per hectare and evaluate the biological carrying capacity of the area, although this method can be timely and costly. "Biological Carrying Capacity typically is defined as the ability of a habitat to sustain a population of animals without degradation of the environment" (Riley et al. 2002, 589). Often, wildlife biologists will look to see if the deer have met or exceeded the local biological carrying capacity. This type of analysis can be achieved by determining if a landscape is severely degraded due to excessive overgrazing by deer. Many argue that deer densities do not have to be regulated according to their own carrying capacities because stability is both unusual and unnecessary in nature (Meshea and Rappole 1997; Sinclair 1997).

Another option used to determine if deer are too abundant in urban communities is the concept of a cultural carrying capacity. For instance, many homeowners often view deer as a valuable aesthetic resource, but are unwilling to tolerate severe damage to property (West and Parkhurst 2002). A "Cultural Carrying Capacity" (CCC) can be defined as "the maximum number of deer that can coexist compatibly with the local human population based on human perceptions, values, beliefs, attitudes, and preferences" (Kilpatrick and LaBonte 2003, 340). Thus, CCCs vary with different geographic locations and human populations. Levels of acceptable wildlife populations are different for different stakeholders (West and Parkhurst 2002). Since a community might be divided on an acceptable density of urban deer, it is often difficult to quantify a cultural carrying capacity. An "Optimum Cultural Carrying Capacity" is defined as "the point at which you reach an equilibrium between those residents who prefer to see more deer and those who

prefer to see fewer deer in their community" (Kilpatrick and LaBonte 2003, 346).

Everyone's idea of a CCC might be different, so this approach results in a larger proportion of the public being content with herd size and densities.

Mitigation

A number of mitigation techniques have been developed to offset impacts on a community caused by an overabundance of urban deer. Deer-crossing signs are the most common technique used to mitigate deer-vehicle collisions, but studies show that many administrators do not believe they are very effective (Sullivan and Messmer 2003). Further, many administrators also believe that deer whistles and mirrors on cars have no effect on reducing deer-vehicle collisions either (Sullivan and Messmer 2003). Finally, high fencing is often seen as the best measure for restricting deer movement across highways and busy streets.

Feeding local deer with corn feeders is very popular in many Texas communities. People enjoy viewing deer in their backyards under feeders, but it domesticates deer and makes them less fearful of humans. It also encourages large congregations of deer, restricts their movements, and enhances their reproduction rates and survival. Many Texas towns have had success with reducing herd sizes and congregations by banning feeding (Creacy 2006).

Landscaping with plants that are less palatable and desirable to deer also mitigate against yards being stripped away (Creacy 2006). Fencing off areas that are desirable to deer, such as gardens and brush areas used by deer for protective screening is also utilized. There are numerous commercial repellents available to apply on and around plants to deter deer; however, the repellents are of limited

success, and tend to only work in areas with low deer densities (TPWD 2006). Noise makers, motion activated lights, silhouettes, and movement contraptions are other measures with various levels of success in repelling deer. However, these approaches are mostly ineffective because deer are so adaptable (Creacy 2006).

Management Options

If a community decides that the biological or cultural carrying capacity of the deer population has been exceeded, residents and leaders are challenged with selecting a publicly acceptable management tool to safely and effectively reduce overabundant deer populations (Kilpatrick and LaBonte 2003). There are a variety of management options for communities wishing to reduce white-tailed deer herd sizes; however, it is a sensitive subject and many people feel different about the different options. Many communities struggle with the difficult task of selecting a publicly acceptable management option (Kilpatrick and Walter 1999). Suburban deer management may be extremely complex and controversial. Even in situations where most people agree that a decrease in wildlife population is desirable, many may disagree as to how to achieve the reduction (Rondeau and Conrad 2003). Another idea to consider is that some wildlife biologists believe that the concept of overabundance only acquires meaning when framed in terms of human values: nature does not care (Caughley 1981; Rutberg 1997). Animals whose lives are strongly affected by human activities should be protected from needless suffering, such as starving, dehydrating, or being constantly hit by vehicles (Rutberg 1997). The fundamental purpose of urban-deer management is to establish and maintain a stable

population of wildlife in order to avoid unacceptable levels of damage to human health, property, and ecosystems (Rondeau and Conrad 2003).

Hunting is the principal tool for managing free-ranging white-tailed deer in America (Kilpatrick et al. 2004) and is preferred by most fish and wildlife agencies (DeNicola et al. 1997; Messmer et al. 1997). Hunting is often the least expensive, most effective, and safest deer management option (DeNicola et al. 1997; Doerr et al. 2001). Urban hunting is effective at not only reducing herd sizes, but studies have indicated that urban deer often change their home-ranges after being hunted (Henderson et al. 2000). Urban deer hunting has been shown to help reduce deer-vehicle collisions (Henderson et al. 2000; Doerr et al. 2001,) and has also been shown to dramatically reduce damage to landscapes, both natural and ornamental, and reduce cases of Lyme disease (Henderson et al. 2000; Kilpatrick and LaBonte 2003). Also, many hunters are willing to donate deer meat to local food banks (Kilpatrick et al. 2004).

However, an urban landscape is a different setting for using hunting as a deer management tool. Hunting is often restricted in urban areas due to weapon discharge regulations and city ordinances, land postings, perceived safety-liability concerns, social attitudes toward hunting and hunters, and political or philosophical conflicts (Kuser and Wolgast 1983; Lund 1997). Attitudes toward hunting differ in urban areas because of safety concerns and fear of hunters (Stout et al. 1997; DeNicola et al. 1997).

Even though many people see hunting as the most effective technique, people will often not prefer it for several reasons (DeNicola et al. 1997; Stout et al. 1997).

First, residents might see wounded or dying deer on adjacent properties, which generates conflicting emotional feelings toward the animals (DeNicola et al. 1997; Kilpatrick and LaBonte 2003). Second, homeowners often fear hunters trespassing on their property (Kilpatrick and LaBonte 2003). Third, many people oppose hunting, not just because it is lethal, but because it is a recreational sport that kills animals. However, bow-hunting within city limits has emerged as a viable alternative to hunting with guns. As discussed later in this review, there are many advantages to using bow-hunting as a management technique.

Another management technique is to trap and release urban deer to an area less populated by humans. Many urban stakeholders who are opposed to lethal control options frequently cite live-capture and translocation as being a viable, more humane alternative to hunting and sharpshooting (Warren et al. 1995; Messmer et al. 1997). Unfortunately, trapping and releasing has been deemed impractical, expensive, and usually results in high post-release mortality (Warren et al. 1995; DeNicola et al. 1997; Messmer et al. 1997; Henderson et al. 2000; Beringer et al. 2002). Another related option calls for managers to trap and euthanize the deer, and donate the meat to local food banks. However, this process is also expensive, labor intensive, and finds low support in many communities (DeNicola et al. 1997).

Sharpshooting is another urban deer management option. Sharpshooting is a lethal method where hired experts who are extremely efficient with rifles kill deer for a community. The sharpshooting usually occurs at night over baited sites to increase kill rates. Although this process is highly effective for reducing deer herd sizes,

sharpshooting is expensive, may be loud and annoying for residents, and may have safety concerns, either perceived or real (DeNicola et al. 1997).

Finally, the use of contraception to reduce urban deer herds is another management technique that has been used experimentally in the United States. This option is also expensive, labor intensive, and usually only used experimentally by wildlife managers (DeNicola et al. 1997). The expenses for this option are paid by the community, not the state. Many deer in the herd must be treated in order for the method to be effective, which is difficult because they are hard to find and must be treated many times. This method does not reduce deer density until a significant amount of deer die off from other causes, which may take years. Some researchers claim that deer contraception works very well, with fertility reductions of 72 to 86 percent (Kilpatrick et al. 1996; McShea et al. 1997) but only after years of contraception practices at work (Kilpatrick and Turner et al. 1997). Up to 5 percent of treated deer can die from the process. Another concern is that with some types of contraception, female deer stay receptive to males for two to three months longer than normal. This puts male deer under more stress and more risk of starving to death. In addition, there also exists the danger in darts lying around on the ground in parks and greenspaces (Kilpatrick and Turner 1997).

Planning and Community Involvement

Once communities have determined that deer management is desired, a management plan must be initiated by community leaders and wildlife biologists. However, the process should not solely include city managers and state agencies; the community must have a voice in the process.

Experience and research demonstrate that well-designed, well-executed stakeholder involvement processes can help agencies and communities resolve conflicts between stakeholders and facilitate implementation of socially acceptable management actions (Chase et al. 2002, 938).

This process can be very complicated and controversial, so steps should be taken to setup an efficient program. On the topic of planning, regardless of the context, Riley et al. (2002, 589) state:

...any decision-making process should minimally include defining goals and objectives in terms of impacts, identifying opportunities and problems, assessing pertinent information, choosing potential alternatives and a course of action, and monitoring performance.

Managers must incorporate local social perceptions into deer management programs (Henderson et al. 2000; West and Parkhurst 2002). The fundamental reason for a management program is to look out for the needs and wants of the community. Residents might have problems with deer, but they might not deem these problems as severe enough to desire lethal methods. Also, if few residents have experience with hunting, it will be unlikely that they will support hunting for management (Stout et al. 1997). Another reason for analyzing community perceptions is because effectiveness is not always residents' primary concern in management, it might be humaneness or cost, so managers should be aware of the community's desires (Stout et al. 1997).

The ultimate goal of community involvement is "to produce consensus from the initial preferences of its members" (Whyte 1989, 41). Does the community desire management, and if so, what kind? Defining community consensus is a difficult task, because of the varying perceptions of what "consensus" is. Some perceive consensus to be defined as 100 percent support and satisfaction, while others might lower the

standard to only 80 percent support. The most basic definition of consensus should, at a minimum, include community members developing a general level of agreement based on fundamental priorities, but should not conclude that majority rules the decision (Markoczy 2001). Even though 51 percent represents the majority of participants, in a decision making process regarding wildlife management, this type of majority of participant support is not considered enough to move forward.

Consensus is not based solely on the level of support among participants, but should also include how strongly for or against people feel about an issue. If a minority of participants feel strongly against an issue, then it is unlikely that an agreement will be reached (Whyte 1989). Any final decisions concerning wildlife management should attempt to reach a middle ground to satisfy residents of the community. One thing *is* certain about consensus: full consent and total satisfaction is rare and it is often difficult to reach an agreement that encompasses both unity and diversity (Fiol 1994).

Understanding the public's concerns about deer management leads to more effective and influential communication. The process is to determine the public's concerns and then distribute information about those concerns. The best way to determine these concerns is through surveys, public meetings, and letters (Lauber and Knuth 2004). Surveying residents is a good technique to learn community perceptions. Internet surveys in particular include the elimination of paper, postage, mailout, and data entry costs (Dillman 2000). The Internet often has better survey capabilities with a more dynamic interaction between respondent and questionnaire (Dillman 2000). Respondents often express their appreciation for the agency's interest in their opinions (Stout et al. 1994). The idea is that residents will more

likely be pleased if the city is taking their opinions into account when making decisions.

"The deer lovers see only healthy deer, the deer haters see only sickly deer" (Kilpatrick and Turner 1997, 516). Almost everyone's perceptions are going to be different, no one thinks exactly alike. Perceptions of the physical damage deer cause may be greater than it is in reality, so managers need to know which is the case (Baker and Fritsch 1997). The opposite might also be the case where people do not perceive any damage at all. People's attitudes toward deer are often in relation to the deer density where they live (Stout et al. 1997; West and Parkhurst 2002). This is important to know when designing a management program because residents from one geographical part of the community might want management while others do not. Understanding the interactions between deer density and attitudes is necessary to effectively manage deer populations (West and Parkhurst 2002). Success of any program also depends heavily on public perceptions of whether or not their desires were achieved (Henderson et al. 2000). Studies show that people most often do notice differences in herd size and damages once deer herds have been reduced (Henderson et al. 2000; Kilpatrick and LaBonte 2003). Also, studies show that once people have experienced hunts in their communities, support is more forthcoming for this option due to the increased awareness of the effectiveness, safety, and results of hunts (Kilpatrick and LaBonte 2003).

In order for community leaders to properly identify whose perceptions are important, they should first identify a list of stakeholders, that is, "any person who will be affected by, or will affect, wildlife or wildlife management" (Decker et al.

1996, 75). Stakes may be cultural, social, political, economic, recreational, or involve health or safety interests. Stakeholders may be homeowners, other real estate property owners, municipalities that manage public parks and recreation areas, or the people who use those locations, such as hikers, skiers, photographers, and nature lovers (Baker and Fritsch 1997). Others include motorists and police officers who often reflect concerns about deer vehicle collisions (Stout et al. 1996). Stakeholders also include people who benefit from human-wildlife interactions and those for whom such interactions cause problems (Riley et al. 2002). Lastly, anyone who influences or makes decisions can be a stakeholder.

Another powerful tool for incorporating public perception into the decision-making process is the creation of a citizen task force (CTF). Creating a citizen task force is a good method for many groups to voice opinions (Baker and Fritsch 1997; Kilpatrick and Walter 1997). CTF groups may ultimately recommend to managers the residents' desires for herd size and the management technique to be used (Stout et al. 1997). Further, CTF groups should be a microcosm of the community they seek to represent, not just select stakeholders, including participants who represent a wide range of attitudes and values about deer in order for the public involvement process to be credible and arrive at a fair recommendation (Sussking and Cruikshank 1987). In addition, CTFs should be equipped with neutral expert facilitators who do not have stake in the process (Stout et al. 1996; Baker and Fritsch 1997). Often, facilitators are wildlife biologists who enter the process already supporting traditional managing techniques such as hunting (Baker and Fritsch 1997).

Communities should go above and beyond basic workshops and hearings to become informed of public attitudes. There are generally three types of people involved in these controversies; deer lovers, deer haters, and those who do not hold strong opinions about deer. It is important to recognize that those with no strong opinions rarely show up at town hall meetings and hearings to voice their opinions. Town hall meetings usually only produce a few opinions from both extreme sides of the spectrum. Also, few cities have actually used a city-wide democratic vote to decide on management options (Kilpatrick and Walter 1997).

Early in the CTF process, wildlife experts should inform stakeholders about deer biology and management options (Stout et al. 1996). Informing the public on management options and deer biology is just as important to the city as being informed about their community's perceptions. The majority of residents often are not adequately informed about deer biology and management techniques. Providing public information through a communication plan and newsletters is highly recommended (Stout et al. 1997; Kilpatrick and LaBonte 2003). Educating citizens allows communities to make informed choices about where they stand on public issues (Bright and Manfredi 1997; McComas and Scherer 1999; Lauber and Knuth 2004).

Studies have shown that information addressing stakeholder concerns will likely influence attitudes (Lauber and Knuth 2004). For example, most wildlife agencies view contraception as experimental, but not a viable solution, however, residents in many communities may disagree and consider it the best management option. Contraception is often attractive to an urban public who are wary of guns and

view it as more humane (Rutberg 1997). Unfortunately, these same residents are usually uninformed on the process. In a few studies, informing the public on management techniques made people far less likely to view contraception as appropriate (Lauber and Knuth 2004). Studies have shown that attitudes toward management techniques are not always fixed. Often, once residents became involved in the management process and properly informed, their attitudes changed. Thus, communication and pertinent information influences community attitudes (Lauber and Knuth 2004).

While community involvement is necessary, wildlife managers often find it difficult to incorporate stakeholders' values into scientific management practices due to stakeholders' inexperience and ignorance of positive and negative aspects of different management options (West and Parkhurst 2002). Communication plans are generally regarded as a necessary component of urban wildlife management programs, but they can also take a long time for managers and delay the process (Kilpatrick and Walter 1997; Stout et al. 1997). The public is simply often uninformed. For example, although bow-hunting is extremely safe and often regarded as the most effective method, many uninformed people fear it and will not support it. Urban home-owners in particular are less experienced with hunting than rural homeowners and often show less support for hunting (Kilpatrick and LaBonte 2003). A situation often results in which city officials, wildlife biologists, and the majority of the community desire a reduction of deer herd sizes by using lethal methods, but a certain percentage of the community delay the process due to uninformed perceptions of safety.

Wildlife managers and city decision makers face challenges in dealing with conflicts among residents with opposing viewpoints and values (Baker and Fritsch 1997). Improving local knowledge, leadership, and collaboration among diverse stakeholders is the best approach for satisfaction in the process (Raik et al. 2006). Collaboration among state wildlife agencies, local governments, interest groups, citizens experiencing impacts from wildlife, and other stakeholders is termed *comanagement* (Schusler 1999; Chase et al. 2000). When comanagement is used in addition to public information efforts, residents and leaders are more likely to produce more educated decisions. A good example of community leaders working together to inform the public is the use of field trips to see damaged plants and deer carcasses on the side of the road (Stout et al. 1997). This idea goes beyond simple mail-outs by the local Animal Services Department. Another recommended approach is to have a public information process followed by a community vote (Kilpatrick and Walter 1997).

Note that while communities should create their own management plan, it is ultimately the state's right to manage wildlife (Hughes v. Oklahoma, 441 U.S. 322, Messmer et al. 1997; Kilpatrick and Turner 1997). With the exception of local mitigation efforts, such as deer-crossing signs, fencing, feeding laws, and so forth, the only way to deploy any capture, transportation, or lethal methods is through state wildlife agency permits. For example, in the State of Texas, a municipality is allowed to trap and remove deer, but only with a Texas Urban White-tailed Deer Removal Permit issued by the Texas Parks and Wildlife Department (Texas Parks and Wildlife Code Sec. 43.0611; Messmer et al. 1997). In many instances, legal

challenges have been made to prevent implementation of lethal approaches. These legal challenges are largely unsuccessful because case law reinforces the state's legal mandate to manage wildlife and conserve habitat (*Humane Society of the U.S. v. County of Monroe N.Y.* 2d 222, N.Y.S. Ct, Messmer et al. 1997). However, stakeholders, not managers, ultimately define and judge the relative importance of human- wildlife interaction effects, thereby determining which effects will be the target of impact management (Riley et al. 2002). Therefore, it is important to remember that although it is ultimately the state's right to manage wildlife, they should do so with the stakeholders' values in mind.

Wildlife Management

Riley et al. (2002, 586) offer a good definition of wildlife management that includes key elements of an emerging paradigm: "Wildlife management is the guidance of decision-making processes and implementation of practices to purposefully influence interactions among and between people, wildlife, and habitats to achieve impacts valued by stakeholders". This definition emphasizes that impacts are effects from wildlife-related interactions or events sufficiently important to warrant management attention and are defined and weighted by human values (Riley et al. 2002). The idea that impacts are defined and weighted by human values is important because all events or interactions have effects of some type and degree, but we only wish to manage impacts if people perceive them and interpret them as producing impacts that warrant management attention. Furthermore, events and interactions may have either positive or negative effects, depending on how stakeholders perceive them, and depending on one's stake. "Thus, different

stakeholders can have different evaluations of the same event or interactions" (Riley et al. 2002, 587).

Human dimensions have now become a sub discipline of wildlife management (Decker et al. 1989; Messmer et al. 1997). In fact, many argue that the effectiveness of wildlife professionals "depend on their skill at integrating biological and human dimensions of wildlife management" (Riley et al. 2002, 591). "Wildlife management does not exist in a human-dimension vacuum; social, cultural, and political forces are part of the context in which management decisions take place" (Messmer et al. 1997, 427). By 2002, Riley et al. explains that textbook definitions of wildlife management did not indicate that the profession had fully embraced multidiscipline management that includes human dimensions in practice.

There is no single management option that works well in all cases, and there is no "cookbook" approach to designing strategy that addresses all complex situations (Chase et al. 2002). Every community is faced with a different situation with residents who have different perceptions. If this is true, there cannot be one state wildlife biologist who can go town to town and tell the community its best plan of action. It takes hard work among an integrated group of professionals from different disciplines. There is a need for integration of multiple disciplines in management, along with diverse stakeholders' participation (Riley et al. 2002).

Bow-hunting

In many instances, bow-hunting continues to be the most efficient and cost-effective option for urban deer-herd control (Lund 1997). The silence and limited range when using the bow and arrow, and the cryptic nature of the bow-hunter,

frequently allows bow-hunting to be more acceptable in many suburban sites where the use of firearms is not a feasible option (Lund 1997). In addition, costs for bow-hunting are usually lower than other management techniques (Kilpatrick and Walter 1999). Although this management option is efficient, it often requires a high level of coordination and work. Urban bow-hunting often requires community and landowner support, political cooperation to change ordinances prohibiting hunting in city limits, hunter proficiency tests, and effective communication strategies (Stout and Knuth 1995; Messmer et al. 1997).

Urban bow-hunting is often preferred over guns because of city ordinances, perceptions of safety by residents of the community, and lack of noise produced by the bow hunters and their bow (Kilpatrick et al. 2004). City ordinances concerning bow-hunting are usually easier to change than city firearm discharge laws. According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (2006, 4), 28 percent of the 12.5 million Americans that hunted in 2006 were bow-hunters. Bow-hunting accidents account for only 2 percent of all hunting accidents, and as of 2001 no injuries have occurred to non-hunters in urban bow-hunts (Swan 2001). This approach is safer because arrows are shot out of a tree, from above, and the arrow's trajectory goes straight into the ground after it goes through the deer. Bow-hunting is a short-range sport where shots are usually taken at a distance of approximately 20 yards. In order to successfully harvest deer, bow-hunters require a perfect line of vision that is in very close proximity. When hunting, bow-hunters are typically silent and motionless all the while maintaining acute awareness of their surroundings. The degree of awareness by the bow-hunter makes it almost

impossible for a bow-hunter to mistake a human for a deer target or for the arrow to hit a passerby. According to the National Safety Council, bow-hunting is far safer than bicycling, swimming, or baseball (National Safety Council 2009).

However, there are negative aspects involved with urban bow-hunting. The deer recovery rate after being pierced by the arrow is not always 100 percent (Kilpatrick and Walter 1999). The emotional, not to mention political, damage that may result from residents seeing a wounded deer running around a neighborhood with an arrow sticking out of it is very real when considering bow-hunting as an option for wildlife management (Kilpatrick and Turner 1997).

Despite the negative possibilities, there are many approaches to make bow-hunting more effective, safer, and acceptable in the community. First, controlled hunts must be done in a professional manner (DeNicola et al. 1997). Urban bow-hunting programs should always be conducted by state fish and game agencies in cooperation with community leaders. All bow-hunting should be done by licensed, qualified volunteers (Stout et al. 1997) who have passed a shooting proficiency test conducted by local managers in conjunction with state fish and game agencies (Kilpatrick and Walter 1999). Qualified bow-hunters who are chosen for a hunt should have a clear understanding of the goals of the program and should have training with speaking with media and any possible protesters (Hansen and Beringer 1997; Doerr et al. 2001). Hunters should be required to attend orientation sessions for proper training in these goals and any handling of the public (Hansen and Beringer 1997; Swihart and DeNicola 1997).

For bow-hunting to be effective, strict hunting restrictions must be implemented (Kilpatrick and LaBonte 2003). Labeling arrows with the shooter's name and address decreases the risk of hunters taking marginal shots (Kilpatrick and Walter 1999). Managers should delineate exactly where hunts should occur and inform adjacent residents that hunting is occurring and post signs (Kilpatrick and Walter 1999). Managers should legally close and restrict access to parks or hunting areas during hunts (Hansen and Beringer 1997; Kilpatrick and Walter 1999). Since falling out of tree stands account for the majority of bow-hunting accidents, hunters should be required to wear safety belts when hunting from elevated stands (Kilpatrick and Walter 1999). Also, as all hunters are taught in most hunter's education courses, it is important to be discrete when loading the carcasses for transport. For example, hunters should not load deer into vehicles during school bus loading hours (Kilpatrick and Walter 1999). The effectiveness of the deer bow-hunts depends several aspects. The outcome of the hunt can be greatly affected by the bow-hunters as well. The hunts may be more effective if hunters target more antlerless deer, which is more effective in reducing herd sizes. Cities might consider rewarding hunters with extra buck tags for more antlerless kills (Kilpatrick et al. 2004).

Urban bow-hunting is easier to conduct on public lands and parks for many reasons. One reason is that homeowners are often reluctant to allow strangers on their land to hunt (Kilpatrick et al. 2007). Traditionally un-hunted places such as parks, estates, golf courses, corporate facilities, and historic sites are some of the ideal sites for urban bow-hunting because they are undeveloped public land and the City often has direct access to them (Lund 1997). However, management may become

more effective if private land owners allow hunters on their land, because deer are spread throughout the city on fragmented small pieces of land.

There are only a few different techniques mentioned in the literature that are used to evaluate the effectiveness of the management process. City animal services or wildlife managers should interview hunters after the hunts to identify any perceived problems. Hunters should be required to register harvested deer at check stations and complete daily surveys. This will allow the managers to evaluate the process, and make changes where necessary (Kilpatrick and Walter 1999). Also, as mentioned earlier, surveying residents on their perceptions of management effectiveness and success is very valuable for managers.

Although costs for bow-hunting are very low (Kilpatrick and Walter 1999), there are some expenses that occur during the process. Signs, letters and postage, deer targets for proficiency tests, and law enforcement officers are the main expenses. The highest costs are usually associated with law enforcement response to protesters (Kilpatrick and Walter 1999). Protesters usually create the only problems in urban hunts, but they are likely to decrease in subsequent years if this management type is continued. A single person who is very knowledgeable about the deer control program should be designated as a contact person to receive and answer questions from the public and media (Doerr et al. 2001).

Literature Review Conclusion

At the surface, urban deer problems might seem to be deer-human conflicts. This might be true for many residents in a community with an overabundance of deer, but not for all. While many people see urban deer as a nuisance, just as many, if not

more, love the deer and have a deep desire to live in harmony with them. This scenario often creates conflicts between humans, which can be far more complicated to solve than deer-human conflicts. Municipalities have to manage the wildlife in addition to the human dimension of suburban wildlife conflicts. This literature review has revealed that communication is the best approach to manage the conflicts that may arise.

Also, wildlife agencies traditionally charged with the management of the deer resource now face problems rooted in social values and legal issues, rather than strictly biology (Messmer et al. 1997). "Traditional, near-exclusive reliance on biological science and expert decision-making is being replaced by multidisciplinary integration and stakeholder participation" (Riley et al. 2002, 585). The old procedure would entail a community's perceived realization of too many deer. A state wildlife biologist would be asked for their opinion and then asked to inform the city council of the community's best management option. This would almost always result in a hunting program in which the decision was made without asking the community's residents for their opinion. Community leaders are now demanding that other opinions, including stakeholders', are taken into account. Furthermore, this need for multidisciplinary integration is replacing the former reliance on the sole opinion of biologists. Over 60 years ago, Aldo Leopold recognized that both social and biological disciplines must be considered in wildlife management. He also recognized that this was not happening, and it would be difficult to accomplish. Many professionals believe that the wildlife profession is still more influenced by the

biological perspective than the social perspective, when both perspectives are equal in importance (Riley et al. 2002).

However, communication plans and multidisciplinary approaches are not easy and can often drag out the process for years. As one author puts it, "Are the public servants charged with deer management in danger of having their management programs held hostage by an increasingly vocal and divided constituency?" (Swihart and DeNicola 1997, 383). Many programs have had difficulties in coming to a final decision because residents have very different opinions and demand to have their preferences expressed in the management. The problem with these vocal residents is that many are uninformed regarding wildlife or the scientific method. This can lead to managers worrying more about political correctness than scientific rigor. Managers cannot always please everyone, and community leaders and wildlife managers have to realize this when undertaking a management process. Residents are not the only entity to fear! Special interest groups based on ill-founded ideas and fears may hold back a management process due to either persistence or power in the community (Swihart and DeNicola 1997).

In conclusion, there is no "cookbook" approach to managing overabundant urban deer herds. In fact, many scientists and researchers have concluded that every community has to create its own management solution where the decision is made with the help of the community. Stakeholder participation should be used to conclude any decision, along with multidisciplinary integration among decision makers. Although the process should include both of these factors, it is the decision makers' responsibility to eventually come to a decision that benefits a majority of the

community and not to let a few special interest groups, or vocal residents, thwart any progress. As one author describes the current status of urban deer, "We suburbanized their historic habitat. Then we built up humanity all around them, so they could not get out even if they wanted to. We owe them a solution" (Kilpatrick and Turner 1997, 519).

III. STUDY CONSTRUCTS

Theoretical Framework

The Attitude-to-Behavioral Process Model (APBM) theoretical approach, which links behaviors and attitudes, provided the theoretical context for this research. This research project focuses on the human dimensions of wildlife management, not the actual biology. The Attitude-to-Behavior Process Model analyzes the process by which a person's attitudes guide behavior intentions. Managers should not only attempt to be aware of stakeholder concerns and attitudes, but they should also attempt to understand the conditions and factors that produce attitudes and behaviors. This theoretical application can be used to predict public attitudes and behaviors toward different management options and help managers make decisions accordingly. When making a management decision, managers want to know how a community is going to react to a decision. Will the community protest and take legal action, or will the community do nothing but thank the managers? These predicted behaviors will often help guide managers to their ultimate decision. Attitude-to-Behavioral Process Models use individual's perceptions to link their attitudes to behaviors. This link is accomplished through attitude accessibility.

The processes of activating or making attitudes available to the mind in the evaluation of a situation is called 'accessibility'. The more accessible an attitude is the greater chance it has of being activated and affecting an individual's perceptions and, in turn, influencing behavior. Experience with an attitude object increases accessibility and the link between attitudes and behavior. (McCleery et al. 2006, 538).

Attitude-to-Behavioral Models also take into account social norms when predicting behavior. So when predicting behavior, these models include social norms, the individual's experience and accessibility, and their attitude.

These data will also serve as input to adaptive management applications of Ecological Adaptation theory. Adaptive Management is an approach to inform management decisions for problems with high uncertainty. Walters (1986) characterizes adaptive management, specifically in the context of wildlife management, in a 4-step process: (1) reaching a consensus among all stakeholders to define an acceptable population size, (2) organizing existing data and modeling to make preliminary predictions about the effects of various management scenarios, (3) identifying and assessing the sensitivity of the assumptions associated with the management program, and (4) implementing management in an experimental context. This study will help local managers develop the first step in this process by understanding stakeholder attitudes and concerns to determine desired outcomes for the community.

Research Questions

This study aimed to better understand residents' perceptions by asking three specific questions:

1. Is there any type of consensus among San Marcos residents on deer overabundance or population management options?
2. How do interactions with deer influence residents' attitudes toward urban deer population management?
3. How do residents' attitudes vary spatially?

I hypothesized that there will be a relationship between respondents' interactions with deer and their attitudes toward urban deer abundance and population management techniques. I also hypothesized that there will not be a consensus in the community on deer abundance, desired management, or desired management options.

Audience to Benefit

The study can benefit The City of San Marcos in making decisions regarding the local urban deer populations and wildlife management. According to the literature, it is important for community leaders and decision makers to understand the attitudes of local residents and incorporate their perceptions and desires into deer management programs (Henderson et al. 2000; West and Parkhurst 2002). In many communities, a handful of residents might desire deer management while the vast majority of residents desire no action. The specific type of management is also often disagreed upon. Many other examples exist where a community might desire management of an overabundant urban deer herd, but effectiveness of the management might not be the only or most important concern of residents. The residents might desire humane treatment of the deer and cost efficiency in the management program before effectiveness is considered. So it is important for managers to know how the community feels about the deer abundance and management options.

This study can also help researchers and managers wishing to better understand community attitudes and the human dimension of wildlife management. Attitude-to-Behavior Process Models address in great detail relationships between attitudes and behaviors. Attitude-to-Behavior Process Models are most often used in

psychology and consumer research but are also highly applicable to analyze the human dimension of wildlife management. This study provides a better understanding of how attitudes form regarding urban deer management based on interactions and accessibility to deer.

IV. METHODS

Survey

Residents in the City of San Marcos, Texas were surveyed in order to understand community attitudes toward the local urban deer. A survey was designed based on successful studies from the literature. The literature offered an abundance of examples of proper questions to be asked to determine where a community stands on a subject. Questions were used from the literature and new questions were developed to be site specific to the study area. The survey consisted of quantitative questions regarding basic demographics, respondents' interactions with deer, attitudes regarding urban deer and management options, and respondents' desires for any management process, including not having management of the deer. There was also a space provided for residents to voice any additional comments, which will be assessed as a qualitative question.

The population studied included residents in and around the City of San Marcos, Texas. An online survey was published on the City of San Marcos website in December, 2009, through January, 2010. The survey was available to anyone with Internet access, either at home or via public computers. City employees hosted the site and maintained it throughout the surveying process. Employees also advertised the survey to residents through a number of venues including the city website homepage, the animal services homepage, a slide on the local public information channel, *Twitter*, the City of San Marcos Library, the San Marcos Activity Center,

City Hall, and the City Utilities Building. Ads were also posted in the *University Star* and *San Marcos Daily Record* newspapers. A sample of 635 respondents participated in the survey in a city with a population of 50,371 people. The data collected are in a digital database.

Table 1 shows the relationship between the research questions and the corresponding methods which were used to answer the questions. The following sections will provide further detailed methods for answering these questions.

Table 1. Research Questions and Methods Matrix.

	Quantitative Analysis	Spatial Analysis	Content Analysis
Is there any type of consensus among San Marcos residents?	X		X
How do interactions with deer influence residents' attitudes?	X	X	X
How do residents' attitudes vary spatially?		X	

Consensus

For the purpose of this study, consensus will be set as 80 percent per response. Of the twenty questions in this survey, nine were eligible to measure consensus among respondents. For example, there cannot be consensus among respondents' age or sex, only their attitudes, beliefs, and concerns. Response percentage rates were calculated for each variable to determine if any percentages were higher than 80 percent. Table 2 below displays eligible variables for consensus.

Table 2. Eligible Variables for Consensus Analysis.

1. Do you believe there is an overabundance of white-tailed deer within the city limits of San Marcos?
2. Do you believe actions need to be taken to reduce the deer population?
3. Which statement best fits your attitude toward our local white-tailed deer populations? <ul style="list-style-type: none"> • The deer do not cause any problems in San Marcos • The deer cause some problems, but not enough to worry about • The deer cause many problems and solutions are needed
4. Would you support a new city law banning residents from feeding the deer in San Marcos?
5. Do you think the city should create a Citizen Task Force of stakeholders to recommend deer management techniques to the city?
6. What are your concerns regarding the results of any deer management conducted in San Marcos? Please rank your attitude toward each issue. <ul style="list-style-type: none"> •Cost •Humaneness •Effectiveness
7. Do you believe bow-hunting to be a humane deer management tool?
8. Which deer management technique would you most prefer?
9. Which deer management technique do you perceive to be most effective?

How do interactions with deer influence residents' attitudes?

This study used the Chi-Square Test of Independence to test the first hypothesis that there is a relationship between respondent interactions with deer and their attitudes toward urban deer abundance and population management techniques. The chi-square test is a test of the influence or impact that a subject's value on one variable has on the same subject's value for a second variable. This is the best test for

determining variable influence for the nominal and ordinal data produced by this survey. It tests if there is any influence on the test variable (residents' attitudes) by the independent variable (interactions with the deer). The two variables are independent if, for all cases, the independent variable has no effect on the test variable. When two variables are independent of one another, there is no relationship between the two. Expected frequencies (what would be expected if variables were independent) are calculated for each cell. The Chi-Square Test of Independence calculates the difference between expected frequencies and observed frequencies. Conceptually, the Chi-Square Test of Independence statistic is computed by summing the difference between the expected and observed frequencies for each cell in the table divided by the expected frequencies for the cell.

The *standardized residual*, or the difference, between the observed frequency and expected frequency is then converted into a Z-score. To determine significant Z-scores, alpha significance scores are used. Standardized residual Z-scores can be positive or negative. Positive scores means that the cell was over-represented in the actual sample, or simply put, there were more subjects in this category than expected. Negative scores mean that the cell was under-represented and there were fewer subjects in this category than expected. An alpha score of .05 means there is a 5 percent chance that the influence is not significant. An alpha score of .05 corresponds to Z-scores of ± 1.96 or greater. An alpha score of .01 means there is a 1 percent chance that the influence is not significant and it corresponds to Z-scores of ± 2.58 or greater. For this study, the lowest percent chance of insignificance is desired, so

standardized residual Z-scores of ± 2.58 or higher will be used to determine if the independent variable is influencing the test variable.

A chi-square test was performed on all variables under investigation using SPSS software. The test was used to determine if there is a relationship between variables that represent respondents' interactions with deer, and variables that represent respondents' attitudes toward deer abundance and management options. The test analyzes all variable response possibilities. For example, the chi-square test does not simply analyze whether or not respondents' have experienced damage to their landscaping influences their attitude toward deer. The test analyzes every response to each question, meaning that it compares all three answer choices for landscape damage (No, Moderate, Severe) to all three answer choices for the respondent's attitude (the deer cause no problems, some problems, and many problems). The tests produced literally hundreds of possible relationships in the resulting crosstab matrices. All relationships between variables that produced a standardized residual Z-score of ± 2.58 or higher were considered significant and were further analyzed. Table 3 below lists independent "Interactions" variables on the left and dependent "Attitude" test variables on the right.

Table 3. Response Variables Analyzed with Chi-Square Test of Independence.

Interactions with Deer	Attitudes Toward Deer and Management
Do you feed the deer?	Do you believe there is an overabundance of deer?
Have you been diagnosed with Lyme disease?	Do you desire reduction in deer herds?
Have you experienced damage to your landscaping?	What is your attitude toward the deer?
Do you use fencing or repellents to protect your landscaping?	Would you support a new law banning the feeding of deer?
Have you ever hunted deer?	Are you concerned about the cost of any management?
	Are you concerned about the humaneness of any management?
	Are you concerned about the effectiveness of any management?
	Do you believe bow-hunting is humane?
	Which management option do you prefer?

A chi-square analysis was also performed on other variables to explore and help better understand respondents' attitudes. Demographic variables that asked respondents if they own property or asked for gender were analyzed to describe how different residents responded. Attitude variables were also tested for independence among each other to determine any possible relationships.

Spatial Analysis

Data Input

Using ESRI ArcMap®, a GIS was used to analyze how residents' responses vary spatially. On the survey, respondents were asked to enter the closest street intersection to their house. Using the street intersection method is useful because it allows for respondents' general locations to be determined without asking for specific addresses. Asking for addresses is too personal and would disrupt the anonymity required for the survey. Asking the respondent for the street name that they live on is not sufficient information for spatial analysis, because San Marcos contains many long streets that extend across town.

After the data were compiled, the street intersections were geocoded into the GIS. An Address Locator was used in the GIS to locate respondents' written street intersection into the GIS. A street's shapefile created by the City of San Marcos in 2006 was used as a base layer for the GIS. From the 638 total responses, 105 respondents did not leave eligible street intersections, which left 533 street intersections eligible for geocoding. Reasons for ineligible responses include not entering a street intersection, not living in or near San Marcos, or entering only one street name. Some responses that contained only one street name were entered into the GIS, because that particular street was short enough and resided only in one neighborhood. For these responses, only streets that are three blocks and shorter were geocoded into the GIS using this criteria.

Each street intersection was entered as a point into the GIS on top of the street's base layer. Each point is connected to the database of responses, meaning

that all responses can be seen for every individual point. This allows for multiple analyses to see how the variables vary across space.

All variable responses were mapped individually in the GIS to determine patterns in spatial variability. This particular approach allows any obvious patterns to be seen without using spatial analysis tools. With each variable and variable response mapped separately, maps can be compared to each other to determine differences or patterns. For example, one side of the city might answer the survey with one response, while the other side of the city might answer with the opposite response.

In this section of the study, a map was utilized that had been created by the researcher from previous work delineating potential urban deer habitat in San Marcos. These data were created by analyzing aerial photographs of San Marcos taken in 2007. A shapefile was created delineating all greenspaces and undeveloped land in San Marcos that deer could possibly use for habitat. Habitat was defined as any undeveloped land that deer might use for feeding or for protective screening (large amounts of brush used for cover). These data were then used in the study to compare respondents' locations and their proximity to deer habitat. During this analysis, an unexpected but potentially significant correlation was recognized. This correlation was found between respondents' damage to landscaping and their proximity to greenspaces and undeveloped lands.

Cluster Analysis

A Cluster and Outlier Analysis was calculated using ESRI ArcMap® to analyze patterns of survey responses. A cluster analysis quantifies geographic variation patterns by measuring Euclidean distances between event-based data in

order to find "clusters" of events. A *cluster* is any spatial pattern that differs in respect to natural variation. Cluster analysis can be used to find patterns of spatially clustered phenomena or to find outliers. For the purpose of this study, the cluster analysis was used to determine if there are any spatial clusters of respondents in San Marcos that have the same attitude toward deer population management or experience similar interactions with deer.

In ArcMap®, separate shapefiles were created for each variable response location. For example, a shapefile was created showing the locations of all respondents who experience severe amounts of damage to their landscaping, and another shapefile was created showing the locations for all respondents who experience no damage to their landscaping. This process was repeated for all variables, thus showing the location of all responses. The Collect Events tool was then used to convert all shapefiles to weighted point data. This tool creates new shapefiles for each variable response and holds the sum of all responses for each unique location. Respondents were asked for the closest street intersection to their house, and in many cases respondents in a similar area used the same intersection. The Collect Events tool weights those intersections to account for all responses for each intersection. This procedure is also recommended by ArcMap® to be performed before conducting a cluster analysis.

A cluster analysis was then performed on each variable response's collected shapefile. This tool creates two outputs per shapefile for the user. The first is the creation of Z-scores for each response location. A Z-score is simply the measure of how many standard deviation units away from the mean a particular value of data

lies. Locations with higher Z-scores display greater clustering, and Z-scores of 2.58 or higher display high clustering. The second output for a cluster analysis is a weighted point in the map. Each respondent's location point on the map has a unique Z-score, which can be visually analyzed.

The output for a cluster analysis is useful whether clusters are found or not. For example, a cluster analysis might find that respondents in one area of the city, all responded similarly. Maybe everyone in a specific area in the city experiences high amounts of problems with the deer. If this is the case, then it is important to know, because it varies from the rest of the city. Cluster analysis is also useful even if clusters are not found. For example, say no clusters are found for respondents attitudes toward deer. The lack of any spatial pattern is still significant because it means that respondents' attitudes are random throughout the city.

Neighborhood Analysis

Respondents' attitudes were also analyzed on the neighborhood scale. Different neighborhoods in San Marcos have different levels of abundance of deer and residents experience different interactions with the deer. Analyzing attitude variance by neighborhood may produce important patterns that vary throughout each neighborhood. For example, if one neighborhood has a high abundance of deer, it is likely that their attitudes will vary from a neighborhood with few deer.

Three neighborhoods were chosen for this neighborhood analysis based on deer abundance and volume of complaints to city officials: Willow Creek, Spring Lake Hills, and Westover. Deer abundance and volume of complaints were determined by Bert Stratemann, the Director of Animal Services for the City of San

Marcos. Willow Creek and Spring Lake Hills are the neighborhoods within San Marcos with the greatest abundance of deer and the highest volume of complaints to the city. Both neighborhoods border the outskirts of town and are surrounded largely by greenspaces and rural land. The issue of deer overabundance and management options is a very hot topic in Willow Creek in particular. Respondents from this neighborhood accounted for 36 percent of total respondents for the survey. Deer can be seen in yards in this neighborhood at all times of the day and many residents have deer corn feeders in their yards. The third neighborhood chosen for the neighborhood analysis was Westover. This neighborhood borders greenspaces and while it does have deer that occasionally roam into the neighborhood, there is no evidence of overabundance based on the criteria used in this study – nuisance reports and severe landscaping damage. This neighborhood was chosen because residents do have interactions with the deer, but few complaints are made from these residents to the city. This study also chose to group and analyze the area east of Interstate 35 due to its low deer abundance. All respondents that live east of I-35 in San Marcos were categorized together for this analysis.

New layers in the GIS were created for respondents from each neighborhood. Each layer contained all respondents' locations and responses for that specific neighborhood. Three variables were analyzed to compare how attitudes vary between different neighborhoods. “Do you believe there is an overabundance of white-tailed deer in San Marcos?”, “Do you believe actions need to be taken to reduce the deer population?”, and “Which statement best fits your attitude toward our local deer populations?” These three variables best represent respondents' attitudes toward the

local deer and any management. Percentages were then calculated for each variable by neighborhood. These percentages were then mapped across the city using the GIS.

Content Analysis

A content analysis was performed on the open-ended "Additional Comments" question that was answered by respondents. These responses were examined for key terms used frequently by respondents, and for interesting and highly emotional comments. Once key terms and ideas were identified, software "Find" tools were used to find all key terms within the data. All responses were reviewed manually for content analysis. There were four types of content examined for this analysis:

1. Comments that elaborate or put emphasis on survey responses
2. Comments that show support for possible relationships between respondents' interactions with deer and attitudes toward population deer management
3. Concerns not mentioned in the survey instrument
4. Interesting and highly emotional comments

Comments that elaborate on survey responses, concerns that were not mentioned in the survey instrument, and interesting comments were all used to help explore and describe respondents' attitudes. A visualization model was developed displaying the spectrum of emotional responses by respondents. Comments that show support for possible relationships between interactions and attitudes were used for support for the quantitative analysis discussion.

Potential Sources of Error and Bias

Although online surveys have become a powerful tool able to draw in large volumes of participants, these types of surveys do have sources of error and bias. This particular survey is at most risk from *Coverage Error*. Coverage error occurs when a mismatch exists between a target population and the frame population (Couper 1997). The target population is the set of persons the researcher desires to study. The frame population can be described as those persons within the target population who have access to the survey (Wright and Tsao 1983). Thus, not everyone in the target population will be in the frame population. For this survey, the frame population is anyone in San Marcos, TX with internet access. An attempt to mitigate coverage error and nonresponse error was made by advertising free computer and internet access for San Marcos residents at the San Marcos Public Library and at the San Marcos Community Center. Anyone who could get to these locations was able to participate in the exam. Also, the web was not the only form of advertisement for the survey; advertisements were placed in newspapers, flyers, and on the public access channel.

Another problem with online surveys is the sheer volume of online surveys that people are exposed to on a daily basis. People can become overwhelmed by the volume of surveys available online. Participants might become insensitive to online surveys, not take them seriously, and fill them out too quick (Couper 1997). Telephone surveys are a good example of this situation. People have been so bombarded with them for years now that the surveys have become annoying, causing people to not participate or rush the process.

Another possible reason for lower response rates could be the difficulties of an online survey interface (Dillman 1978). Although many people might have access to the internet, some might find internet surveys difficult to complete relative to traditional surveys such as paper-and-pencil mail surveys (Couper 1997). This might discourage some people from participating in the survey.

There is also a potential of bias in this survey due to the emotional character of the topic. Surveys that ask questions regarding a sensitive nature can sometimes lead to untruthful answers (Kuk 1990). This is often due to respondents' lack of trust in the randomization process. Respondents might not trust that their identification is protected. An example of this in this survey is the question "Do you feed the deer with corn or other supplements?" People might be hesitant to answer "Yes" to this in fear that the survey might be used to identify them if a law is passed banning the feeding of deer. Another example might simply be that some participants do not want their neighbors finding out how they responded.

Another source of potential bias might be from participants responding in a certain way in order to skew the results. This occurs in surveys where the research itself has social implications for the surveyed population (Sieber and Stanley 1988). Participants have their own agenda and might try to answer questions in a way that might influence the survey results in their favor, regardless of how they might actually feel. An example in this survey might exist in when respondents were asked about their attitude toward the deer. Someone might believe that there is an overabundance of deer that cause many problems for a lot of people, but they personally like having a large volume of deer in the community. A respondent might

not answer truthfully and state that there is not an overabundance of deer and they do not cause problems. This might skew the results in favor of not removing deer, even though that respondent believes the deer cause problems.

V. RESULTS

Descriptive Analysis

Table 4 below summarizes the results from the survey. The complete set of survey results can be found in Appendix B.

Table 4. Results Summary.

Survey Response	(N)
Total responses	638
Respondents residing in the City of San Marcos	78.6% (497)
Respondents reporting damage from deer	60.8% (363)
Respondents who think there is an over-abundance of deer in the city limits	60.8% (363)
Respondents who think action should be taken to reduce deer population	56.7% (335)
Respondent attitudes:	
The deer do not cause any problems in San Marcos	11.4% (68)
The deer cause some problems, but not enough to worry about	43.6% (259)
The deer cause many problems and solutions are needed	44.9% (267)
Respondents who use fencing or repellents to protect property from deer	49.8% (297)
Respondents who feed the deer with corn	11.9% (71)
Respondents who would support a new law banning residents from feeding the deer in San Marcos	57.1% (337)
Respondents who think the city should create a Citizen Task Force to recommend deer management techniques	57.3% (336)
Respondents who have hunted deer	40.3% (239)
Respondents who believe bow-hunting is humane	58.1% (338)
What deer management technique would you prefer?	
Trap and Release	25.0% (148)
Trap, Transport, and Process Meat	20.8% (123)
Bow-hunting	15.9% (94)
Tranquilize and Euthanasia	4.6% (27)
Hire Sharpshooters	5.4% (32)
Reintroduce Natural Predators	4.6% (27)
Take No Action	23.8% (141)

Of the 638 respondents that completed the online survey, only 326 added additional comments at the end of the survey. Only 11 respondents claimed to have been diagnosed with Lyme disease, 2 of which commented that they contracted this out of state. These data suggest that Lyme disease is not a problem in this area.

Consensus

As illustrated in Figures 1 through 9 below, respondents to this survey displayed little consensus toward deer abundance or population management options. Within the survey, nine questions were eligible for consensus among residents (Table 2) but only two questions resulted in a consensus (Figures 11 and 12). The majority of questions resulted in percentage rates that were split between 60 percent versus 40 percent. For example, 57 percent of respondents desire a reduction of white-tailed deer in San Marcos while 43 percent do not desire any management. This 60 percent versus 40 percent response trend can be seen in 5 of the 9 questions eligible for consensus.

Respondents were also asked "What deer management technique would you most prefer?" Seven management options were available to choose from, including "Take no action." The highest response percentage for any option was 25.2 percent, indicating absolutely no sign of consensus, as seen in Figure 10 below.

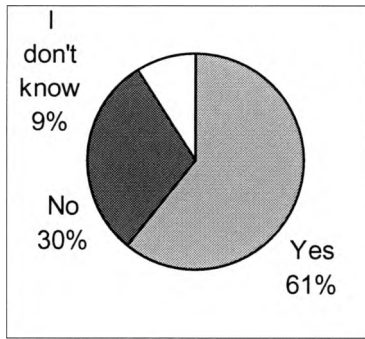


Figure 1. Perceptions of Overabundance

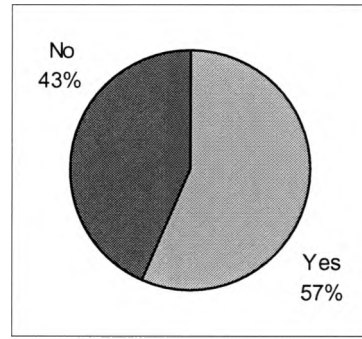


Figure 2. Respondents Who Desire Management

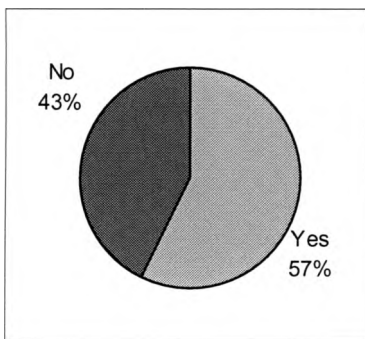


Figure 3. Support for a CTF

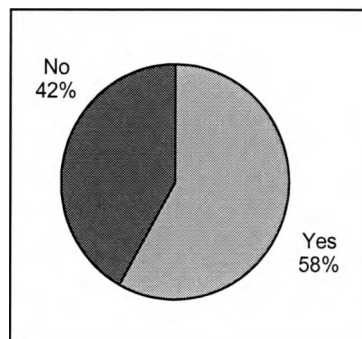


Figure 4. Is Bow-hunting Humane?

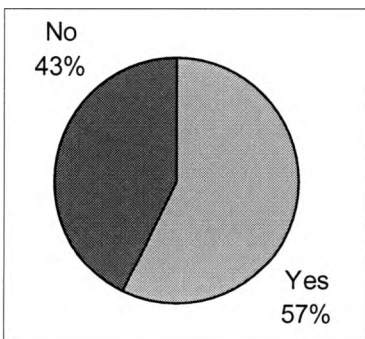


Figure 5. Support for Banning Feeding

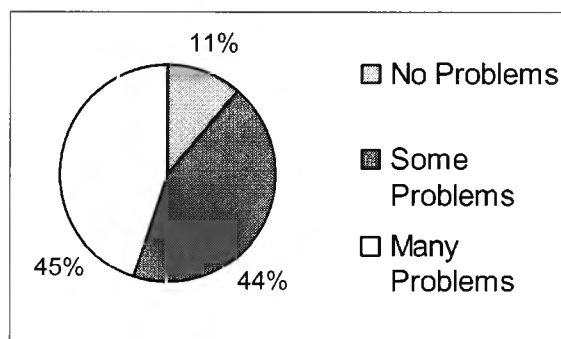


Figure 6. Attitudes Toward Deer

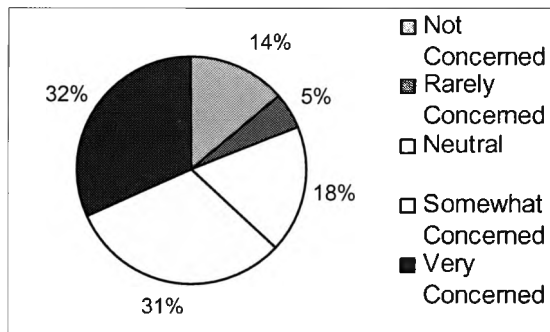


Figure 7. Concerns for Cost

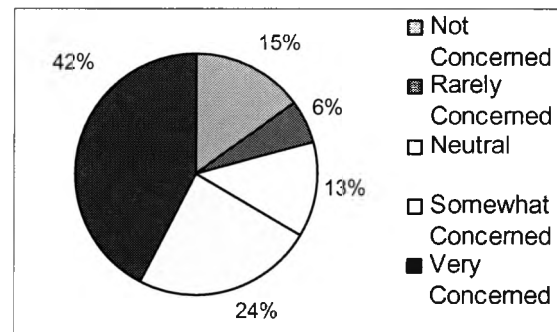


Figure 8. Concerns for Humaneness

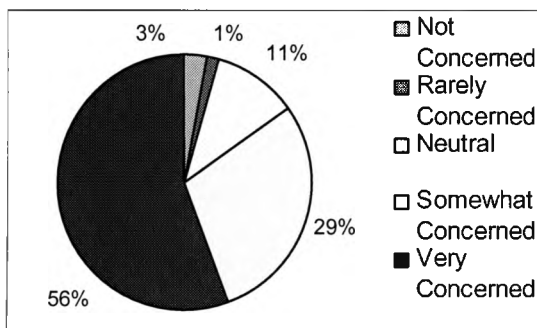


Figure 9. Concerns for Effectiveness

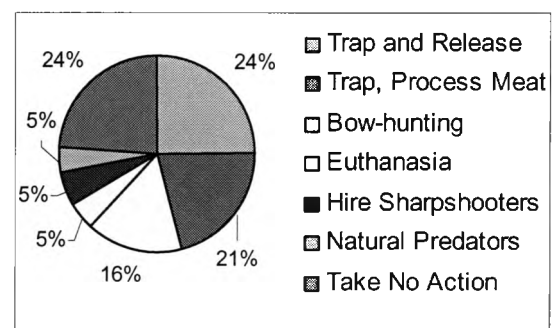


Figure 10. Preferred Management

Two questions resulted in a consensus among respondents (Figures 11 and 12). When asked about their attitude toward the local deer populations, 88.5 percent of respondents answered that deer do cause problems (Figure 12). Even though there is a consensus in San Marcos among residents that they perceive the deer to be causing problems, the respondents are still divided on whether or not management is needed to correct these problems. Half of the respondents to this question believe there are problems, but not enough that the City should interfere, and the other half of respondents deem these problems worthy of finding solutions.

Question 12 asked respondents "What are your concerns regarding the results of any deer management conducted in San Marcos?" Respondents were asked to rate

their concern for cost, humaneness, and effectiveness of the deer management techniques that could take place in San Marcos. Respondents did not come to a consensus in regard to cost or humaneness. Effectiveness did result in a consensus among respondents because 85 percent of respondents would be concerned about effectiveness (Figure 11).

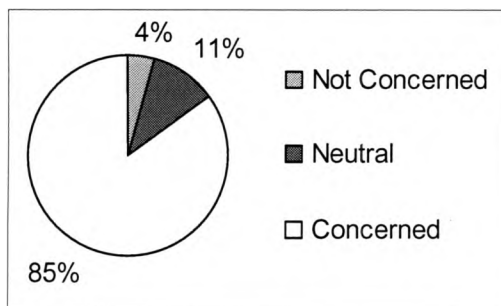


Figure 11. Concerns for Effectiveness

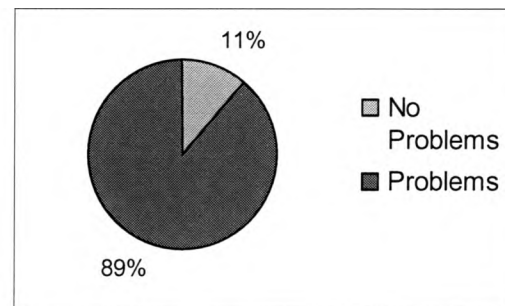


Figure 12. The Deer Cause Problems

How do interactions with deer influence residents' attitudes?

The Chi-Square tests of independence produced multiple significant relationships between independent "Interactions" variables and dependent "Attitudes" variables. Only variable comparisons with standardized residual Z-scores of ± 2.58 were considered to be significant. Table 5 displays all relationships where independent "Interaction" variables influenced dependent "Attitude" variables.

Table 5. Interactions Influencing Attitudes.

	Do you feed the deer?	Do you experience damage to your landscaping?	Do you use fencing to protect your property?	Have you ever hunted deer before?
Do you perceive an overabundance of deer?	X	X	X	
Do you desire a reduction in deer herd sizes?	X	X	X	
What is your attitude toward deer?	X	X	X	
Would you support a law banning the feeding of deer?	X	X		
Are you concerned about the cost of management?		X		X
Are you concerned about the humaneness of management?	X	X		X
Are you concerned about the effectiveness of management?		X		
Do you believe bow-hunting is humane?		X		X
Which management option do you prefer?	X	X		X

Table 6. Demographics and Attitudes Influencing Attitudes.

	Sex	Property Owner	Do you perceive an overabundance of deer?	Do you desire a reduction in deer herd sizes?	What is your attitude toward deer?
Do you desire a reduction in deer herd sizes?			X		
What is your attitude toward deer?			X		

Table 6- Continued					
Would you support a law banning the feeding of deer?			X		X
Are you concerned about the cost of management?			X	X	X
Are you concerned about the humaneness of management?	X		X	X	X
Are you concerned about the effectiveness of management?			X	X	X
Do you believe bow-hunting is humane?	X				
Which management option do you prefer?			X	X	X
Do you use fencing to protect your property?		X			

Tables 7 through 10 below display significant standardized residual Z-scores for variable responses with significant correlations. Only Z-scores of +/- 2.58 or higher are considered significant and are used in these tables to show correlations. The higher the Z-score, the more likely a respondent was to have answered with both of the responses. For example, in Table 7, a Z-score of 3.1 was produced for respondents who feed the deer but do not believe there is an overabundance. This means that people who feed the deer are far less likely to perceive an overabundance of deer. Negative Z-score are significant as well because they indicate that respondents are far less likely to answer two different responses. For example, in Table 7, a Z-score of -3.6 was produced for respondents who answered "Yes" to feeding the deer and "Yes" to desiring reduction. This means that respondents who feed the deer are far less likely to answer "Yes" to desiring reduction.

Table 7. Do you feed the deer with corn?

	Overabundance?		Desire Reduction?		Attitude		
Feed?	Yes	No	Yes	No	No Problems	Some Problems	Many Problems
Yes		3.1	-3.6	4.1	3.8		-4.4
No							

	Support Banning Feed		Humane Concerns		Preferred Management	
Feed?	Yes	No	Low	High	Trap and Process Meat	Take No Action
Yes	-4.9	5.7		3.4	-3.1	5.1
No						

Table 8. Do you experience damage to your landscaping or property from deer?

	Overabundance?			Desire Reduction?		Attitude		
Damage?	No	Yes	I Don't Know	Yes	No	No Problems	Some Problems	Many Problems
No	6.2	-4.7			5.2	6.3	2.7	-5.9
Moderate						-3.5		
Severe	-5.9	5.2	-2.7	5.9			-6.7	8.6

	Support Banning Feed		Bow-hunting Humane?		Preferred Management		
Damage?	Yes	No	Yes	No	Trap and Process Meat	Euthanasia	Take No Action
No	-3.8	4.4		3.4			5.2
Moderate							
Severe	5.3	-6.1	2.9		2.7	3.1	-4.7

	Humane Concerns			Cost Concerns	Effectiveness Concerns
Damage?	Not	Rarely	Very	Not	Neutral
No			4.0		
Severe	4.8	2.9		2.9	-2.8

Table 9. Do you use fencing or other repellents to protect your landscaping from deer?

Fencing?	Overabundance?			Desire Reduction?		Attitude		
	No	Yes	I Don't Know	Yes	No	No Problem	Some Problems	Many Problems
No	3.3				3.2	3.4		
Yes		3.1		2.8				3.7

Table 10. Have you ever hunted deer before?

Hunted?	Cost Concerns	Humane Concerns		Bow-hunting Humane?	Preferred Management	
	Very	Not	Very	No	Trap	Bow-hunting
No	-2.6					-3.9
Yes	3.1	2.7	-2.6	-2.9	-2.7	4.7

How do residents' attitudes vary spatially?**Descriptive Analysis**

A total of 533 respondent locations were entered into the GIS (Figure 13).

From the total respondents eligible for geocoding, 42 percent live in the Willow Creek neighborhood and most street intersections in this neighborhood display multiple respondents. This was the only area of San Marcos to display such concentrated volume of responses. A total of 186 respondents live throughout the heart of the city and are spread out, displaying no significant densities. The remainder of respondents appear to be outliers living on the fringe of city limits. Very few respondents (13) live on the East side of I-35.

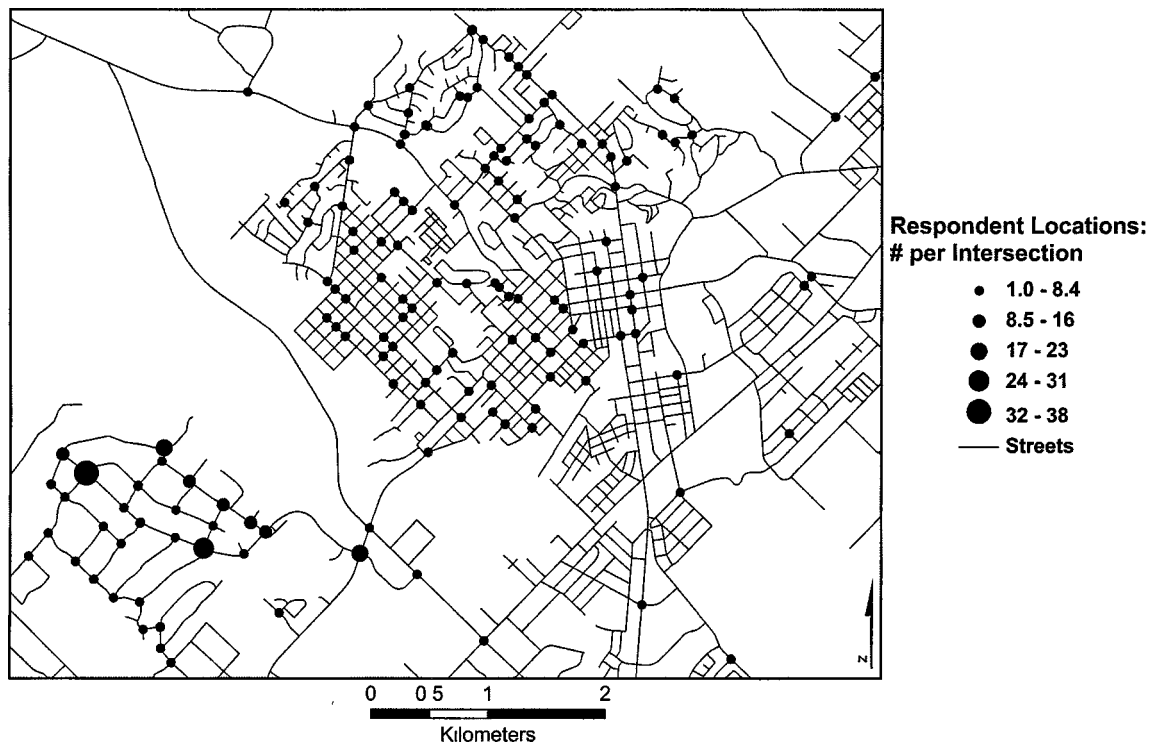


Figure 13. Map. Respondent Locations.

All variable responses were mapped and compared to one another to determine any differences or spatial patterns. With few exceptions, these maps showed that there were no spatial patterns to the responses. Comparing the responses for each variable produced maps that look quite similar and no patterns can be detected. For example, when comparing respondents who desire a reduction in deer herd sizes to those respondents who do not desire a reduction, the responses were spread randomly throughout the city and there was no part of the city that had significantly dense areas of high volumes of responses (Figure 14 and Figure 15).

This seemed to be true for almost all variable responses; very few patterns could be detected.

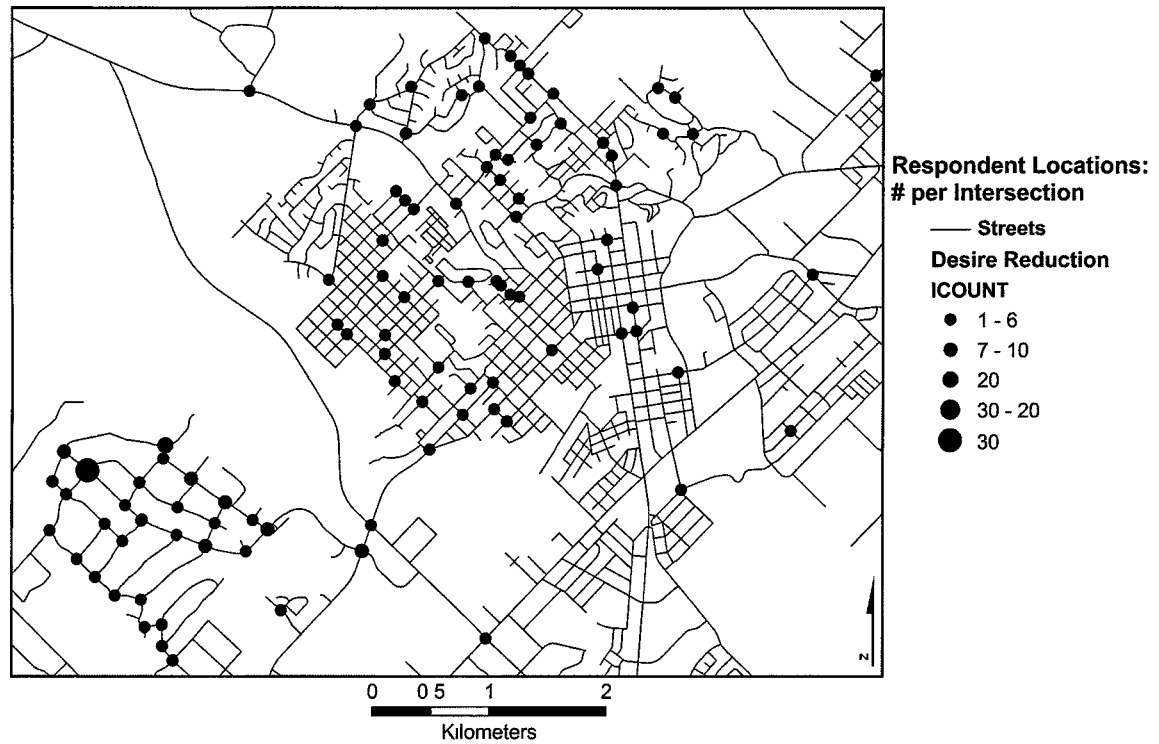


Figure 14. Map. Respondents Who Desire Reduction in Deer Herd Sizes.

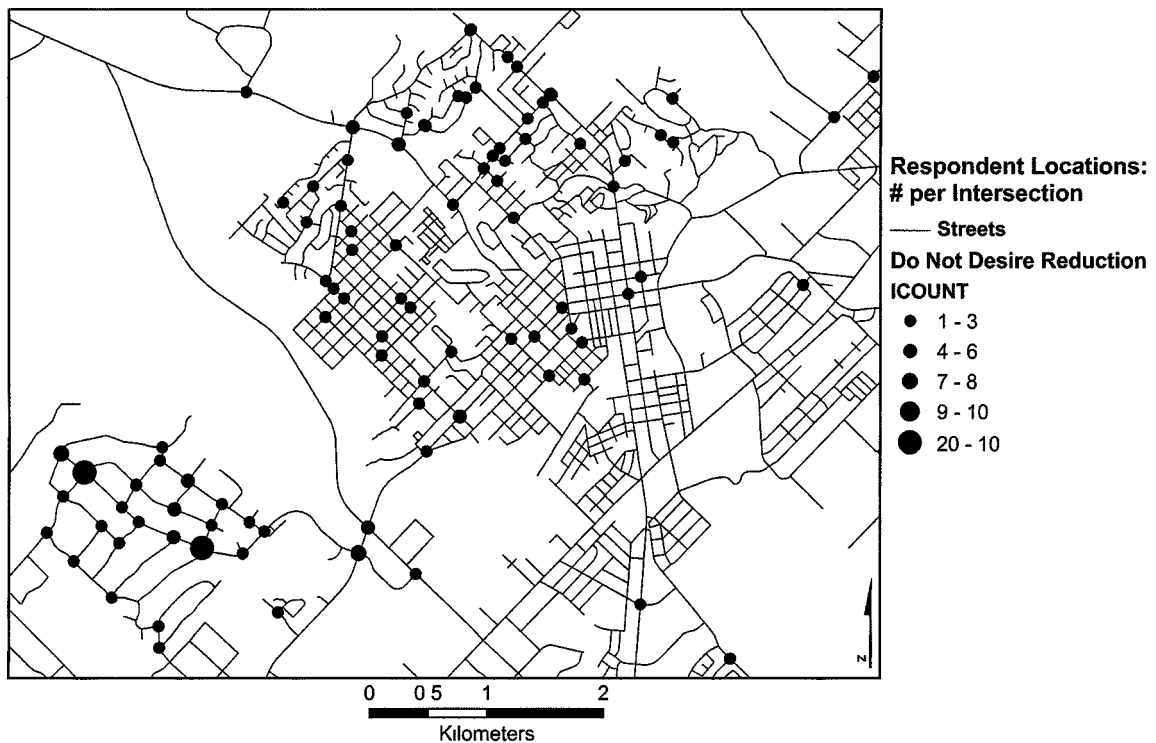


Figure 15. Map. Respondents Who Do Not Desire a Reduction.

There were three interesting observations produced from comparing variable response maps. First, the respondents that selected "Severe Damage" to Question 10 "Do you experience damage to your property or landscaping from deer?" tend to live either on the edges of town, bordering a greenspace, or in the Willow Creek neighborhood. There are a few examples of respondents who experience severe damage in the middle of town, but the majority of respondents who perceived that deer cause "Severe Damage" seem to live at the wildland-urban interface. Figure 16 shows these response locations and their proximity to greenspaces and undeveloped land that are potential urban deer habitats.

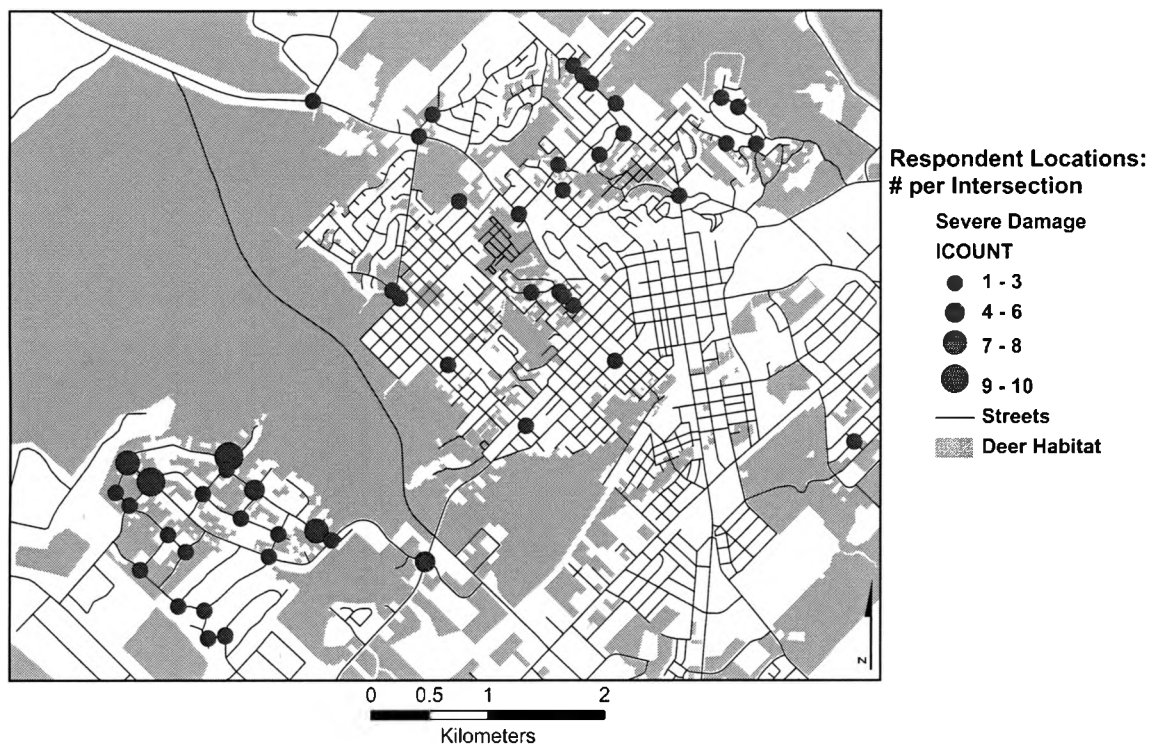


Figure 16. Map. Proximity of Respondents Experiencing Severe Damage to Landscaping to Greenspaces.

Another observation is that the majority of respondents that feed deer with corn or supplements live in Willow Creek. Of the 71 respondents in San Marcos who claim to feed the deer, 54 percent live in Willow Creek (Figure 17).

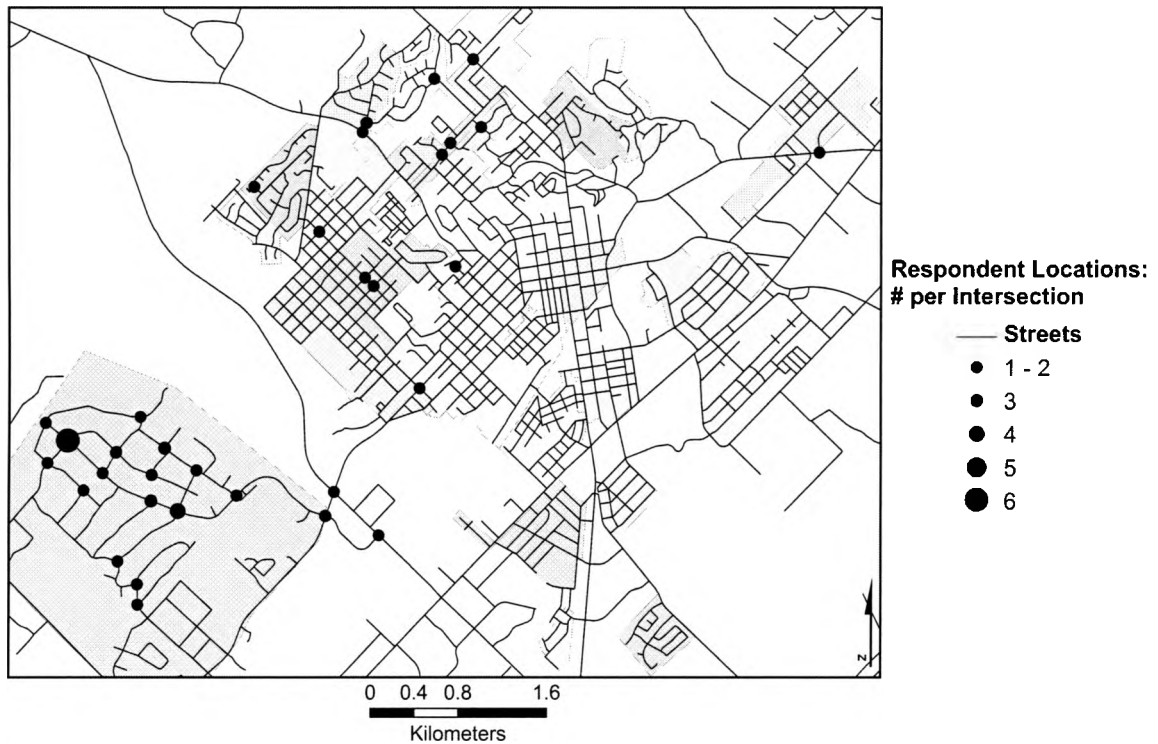


Figure 17. Map. Respondents Who Feed Deer Per Neighborhood.

The final major observation is that several neighborhoods in San Marcos produced very few respondents. The majority of neighborhoods produced respondents, but ten neighborhoods produced few to zero respondents. Figure 18 shows the location of all respondents and respective neighborhoods. The neighborhoods with low respondent rates all tend to be on the East and South sides of San Marcos.

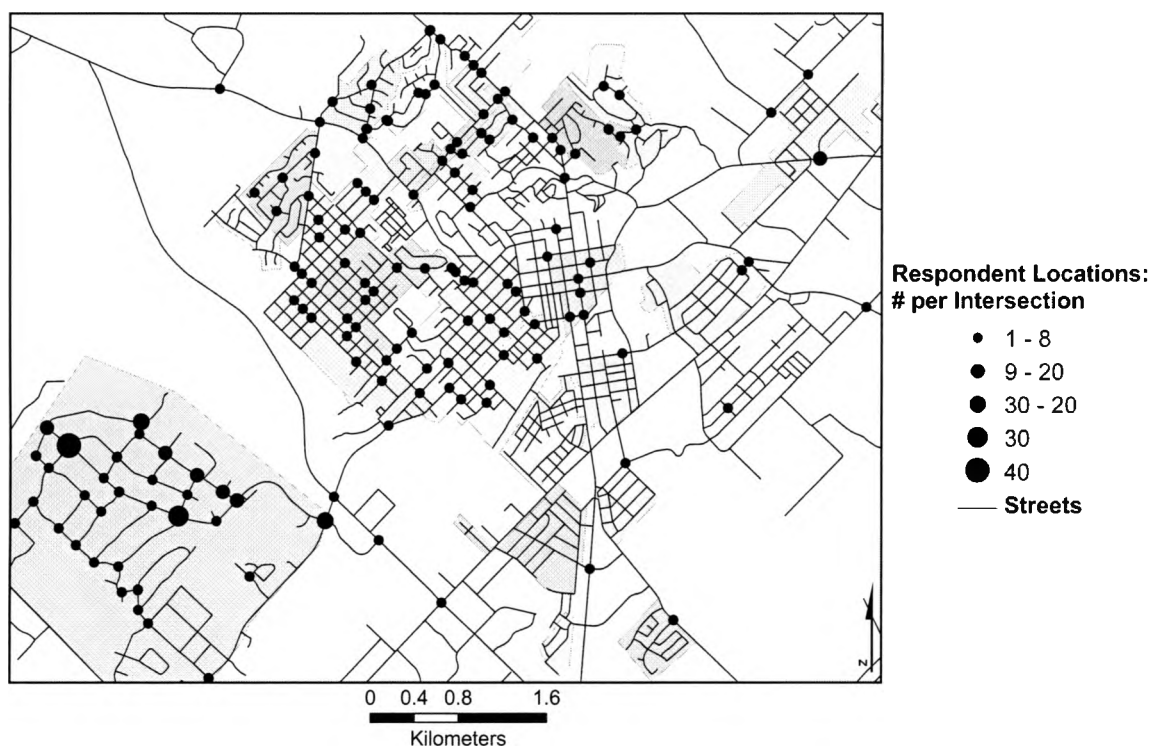


Figure 18. Map. Respondent Locations by Neighborhood.

Cluster Analysis

The first cluster analysis was performed on all respondents' locations and then on all other variable responses. The cluster analysis for respondents' locations resulted in high clustering in the Willow Creek neighborhood, which is on the southwest side of San Marcos. In Willow Creek, 16 intersections resulted in Z-scores of 2.58 or higher. No other clusters were found throughout the city. Intersections throughout the rest of the city displayed Z-scores between -1.65 and 1.65, which represents random spatial variance. Of all the neighborhoods in San Marcos, the Willow Creek neighborhood displayed a high volume and density of respondents.

Respondent locations for the rest of the city were randomly distributed and no patterns could be found.

A cluster analysis was then performed for all variable responses. Four variable responses displayed no clustering: (1) respondents who believe the deer cause no problems, (2) those not concerned with the effectiveness of any deer management, (3) those who prefer euthanasia as a management option, and (4) those who prefer reintroducing natural predators as a management option. All other variables resulted in clustering, but again, only within the Willow Creek neighborhood. The measured variables produced between 2 and 15 intersections in Willow Creek with Z-scores greater than 2.58. This is due to the high volume of response rates in this neighborhood and the density of respondent locations. The remainder of the city displayed no clustering of any variable response, which supports the conclusion that responses were randomly spread throughout the city.

Neighborhood Analysis

Attitudes and locations of respondents vary significantly between the three selected neighborhoods and the area east of I-35. From the Westover neighborhood there were 32 respondents, 226 from Willow Creek, 11 from Spring Lake Hills, and 13 east of I-35. Neighborhoods on the east and south sides of San Marcos were not eligible for a neighborhood analysis due to lack of respondents.

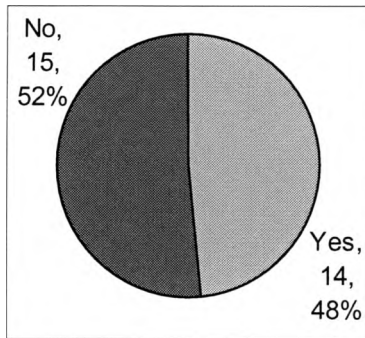


Figure 19. Westover Neighborhood. Perceptions of Overabundance.

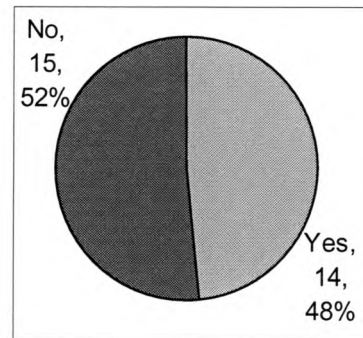


Figure 20. Westover Neighborhood. Desire for Management.

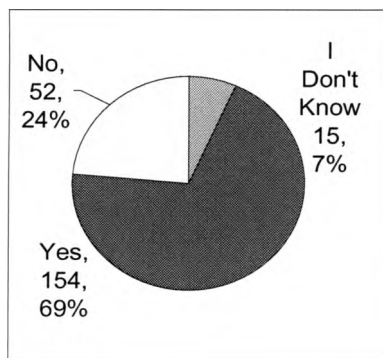


Figure 21. Willow Creek. Perceptions of Overabundance.

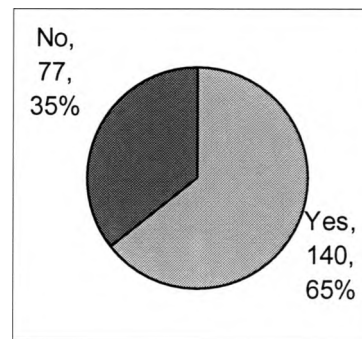


Figure 22. Willow Creek. Desire for Management.

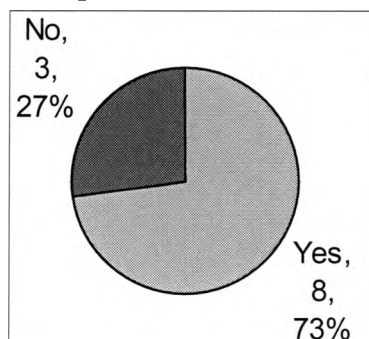


Figure 23. Spring Lake Hills. Perceptions of Overabundance.

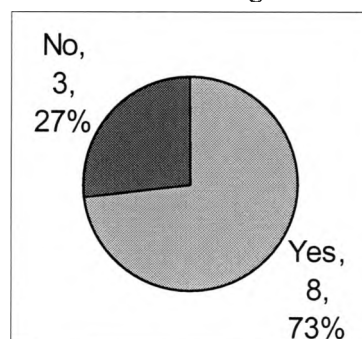


Figure 24. Spring Lake Hills. Desire for Management.

Figures 19 and 20 illustrate that respondents' attitudes from the Westover neighborhood are evenly divided, but the majority of respondents do not think the

deer are overabundant or that they cause a problem. A significantly large number of total respondents reside in Willow Creek (Figure 25). The majority of respondents from Willow Creek believe there is an overabundance of deer and solutions are needed (Figure 21 and Figure 22), but there is no consensus among respondents regarding the action that should be taken (Figure 22). The majority of respondents in Spring Lake Hills also believe there is an overabundance of deer and management is desired (Figure 23, Figure 24). Only 13 respondents reside on the east side of I-35. The majority of these respondents believe there is an overabundance of deer and management is desired.

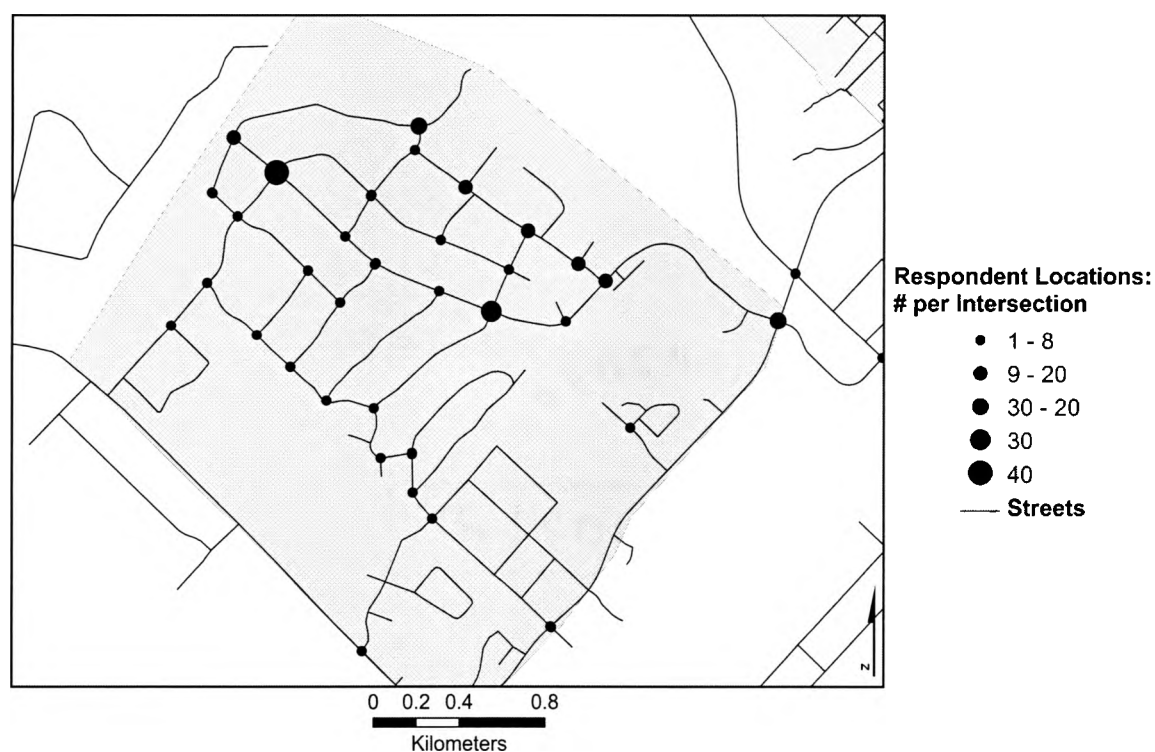


Figure 25. Map. Willow Creek Respondents.

Content Analysis

The “Additional Comments” question was answered by 326 respondents.

Many key terms and concerns were discovered in the content analysis. These key comments and concerns were then quantified and Table 11 was developed to display the results.

Table 11. Content Analysis Key Comments Quantified.

Respondents' Concerns	Examples	Total
Donating Venison to Hungry	"The food bank is always in need of food."	46
"The Deer Were Here First!"	"We encroached on their land Leave them alone!"	45
Support for Hunting	"I believe that a properly managed bow-hunt would be the most effective cost efficient means of successfully controlling and maintaining the deer population."	44
Deer-Vehicle Collisions	"The community will only come together on this when a motorcyclist or passenger in a car is killed from hitting a deer."	32
Feeding Corn to Deer	"They are all over the place, we need to ban feeding at the minimum."	26
Damage to Landscaping	"I can't grow flowers and have a garden because of the deer population in my area."	22
Deer as a Hazard	"They are a hazard to drivers on the road." "The deer can still be dangerous wild animals, especially during mating season."	20
Deer Enhances Individual's Life	"The deer in San Marcos are a pleasant surprise every time I see them."	19
Suggest Proper Plants to Residents	"I planted a limited amount of landscaping that are deer proof and I live with it."	15
Fear of Hunting	"Any hunting within the city limits or community area is dangerous and flat stupid."	14
Concerned about Tax Money	"Trying to 'manage' deer is a waste of money " "Do not want my tax dollars spent on an issue that will not benefit the entire city "	12
Educate the Public	"Education is often/ always a major key." "People in San Marcos need to be educated to the fact that feeding the deer is not humane."	11
Concern for Health of Deer	"I am concerned about the deer because of lack of food and water."	10
Concern for Disease	"Too many deer in my area causes me to be concerned about disease from droppings."	9
Desire for TPWD Involvement	"Perhaps work closely with State Parks and Wildlife to determine best course of action."	5
Speed Limits and DVCs	"The deer are also a naturally occurring deterrent to people who like to speed through neighborhoods." VS "Going 30 miles per hour in two separate years, I have been T-Boned by deer causing damage to my car."	5

The subject that was mentioned most in the "Additional Comments", other than just deer, was respondents' illustrating their desire for meat to be donated to feed the hungry in the area. These comments ranged from "There are hungry people in our city that could benefit from having the meat processed for food" to "I'd favor both Trap and Release and Archery Hunts, especially if the meat is donated." Respondents showed support for donating venison to feed local hungry families. One respondent even did some research: "Bon Tons Meat Market! The FHFH program pays for the processing, so it helps to eliminate the over population and also helps the food banks and helping hands programs feed the hungry." This respondent is referring to Farmers and Hunters Feeding the Hungry, a Christian organization that will pay local butchers for processing fees for venison if it goes to local food banks. This would mean the city would only have to pay for transportation of the meat to and from Bon Tons Meat Market. There were no negative comments made regarding this subject, but a few respondents showed concern for liability issues in donating meat.

The perception that the deer were here first and humans encroached into their environment was the reasoning of 45 respondents for not supporting deer management. Many statements aimed at protecting the deer were made as well. "The deer were here first. Live with it" is an example of this type of response. These responses tended to be highly emotional, many of which seemed to be in disbelief that the City of San Marcos would consider any kind of techniques to manage the deer. "The deer were here first, and we all knew that fact when we bought our homes. Those who don't like deer are more than welcome to leave." These responses varied in context, but all were used as reasoning to not manage the deer.

A handful of respondents (44), showed great support for hunting and/ or bow-hunting within city limits as a means to manage deer herds. Respondents made comments supporting hunting as a legitimate management technique to be used in the city limits. One respondent thought it would be a good idea to "Initialize a permit system for qualified archers to humanely harvest the deer." Most supporters of hunting also stated their desire for the meat to be given to the hungry. "Allow hunters to hunt in city limits during deer season. Give the meat to the poor." Many of these respondents also displayed their belief that hunting is humane. "I believe that the humane death of animals can be accomplished through shooting (skilled archery or gun) and this additionally leaves the meat clean for human consumption."

Some residents showed support of hunting only under certain conditions. For example, "If archery hunts are permitted, I would feel more comfortable with well qualified hunters with proper licenses." This respondent does not seem too enthusiastic about hunting, but if it does occur, she wants it to be conducted using specific and legal means. Other respondents made similar comments expressing their desire for intense regulation for any hunting performed. Others insisted that if hunting occurred, all meat must be donated in order to have their support. "I think that if bow hunting were the solution, then the deer need to be processed and donate the meat to the needy." Another desired requirement was "If you are going to have management hunts in San Marcos, it should only be citizens of San Marcos doing the hunts."

Some respondents like the idea of charging bow-hunters for licenses. "Sell bow hunting permits and MAKE some money for the city. Donate some of the meat

to the Food Bank.” “We should charge for urban deer hunts to reduce the population and also pay to reduce in areas we are unable to hunt. This should be a cost neutral operation. Thus we must charge for deer hunts.” This way the deer population is reduced and the City makes money to account for any expenses.

A few respondents thought it would be a good idea to combine hunting with other methods to reduce deer populations. “You forced me to make only one choice in questions 18 & 19. I think a combination of trapping, archery hunts & predators, etc. would work best.” “It will take several combined approaches to reduce deer densities and continued actions to keep them under control.” These respondents were not satisfied with having to choose only one preferred management technique and would prefer a combination of techniques.

Many respondents commented on concerns about the efficiency of bow-hunting. “My primary concern with bow-hunting is the difficulty of a quick kill and the increased chances of a wounded deer escaping hunters.” This respondent is skeptical of the efficiency and humaneness of bow-hunting and other respondents made similar remarks concerning efficiency and humaneness. “How can one consider bow-hunting to be a humane management tool? More chance of wounding the animal. Often the deer is wounded only to suffer a slow painful death.”

The majority of concerns about hunting pertained to safety issues. Many respondents perceive hunting and bow-hunting to be unsafe in an urban environment. One respondent explained that “We are too big a city now to allow hunting by anyone within city limits, either by bow or gun. All it takes is one 'accident' or 'miss' by an expert, no one is a 100% perfect shot, and an innocent person can be hurt or killed.”

Many respondents displayed little faith in hunters being able to safely perform this task. "Allowing bow hunting within the city limits would seriously compromise public safety." Many statements were made similar to this one: "I do not think bow hunting IN THE CITY is a good idea. It seems dangerous." No respondents mentioned that hunting in general is not safe, only that hunting within the city might not be safe. Of the 14 respondents that commented on their concerns for public safety and hunting, 3 answered "Yes" to have hunted before, 10 stated to having never hunted, and 1 skipped the question.

Many respondents left comments that were against hunting. "Bow hunting would be barbaric, already people having deer feeders, which tame deer then shooting them as they feed is barbaric not real hunting." Another quick comment was simply "NO BOW HUNTING!" Some respondents gave reasons for being against hunting, safety being the number one reason. "Any hunting within the city limits or community area is dangerous and flat STUPID!" A few other respondents claimed to be against hunting but gave no reasoning. "I would not like archery hunts, sharpshooters, natural predator introduction, or euthanasia in my neighborhood."

Many comments were made by respondents displaying their concerns for deer-vehicle collisions. Deer-vehicle collisions were a reasonable concern for reducing the deer populations in San Marcos for 32 of the respondents. "I have fairly often just barely missed hitting deer when they sprang unexpectedly in front of my car. I know that it is only a question of time until it happens. Also, I was not speeding." "I have also witnessed many car-deer accidents during this nightly deer invasion." Some respondents cited deer-vehicle collisions as their only reason for

any deer management. Many people can tolerate deer eating their landscaping, but deer-vehicle collisions are not acceptable to them. Deer-vehicle collisions were not addressed directly in the survey so the concerns addressed in the "Additional Comments" section were useful. The respondents concerned about deer-vehicle collisions had a general attitude that there are too many deer and solutions are needed.

Some respondents claim that "the deer are also a naturally occurring deterrent to people who like to speed through neighborhoods." These respondents believe that with the deer so abundant in yards and streets, they cause people to drive slower. Some residents believe that if you drive at the speed limits, it is near impossible to hit a deer. "I have never came (sic) close to having a deer collision because I don't drive over the speed limits." Other respondents claim to have been going very slowly and still either hit deer or have been hit by deer. "Going 30 miles per hour in two separate years, I have been T-Boned by deer causing damage to my car."

Other respondents cite damage to their landscaping and property as a reason to manage the local deer herds. Twenty-two respondents claimed to have received damage to their landscaping or property and believe this warrants deer management. Some respondents take landscaping seriously and do not think they should have to tolerate this interaction. "The deer are extremely destructive and negatively impact my quality of life. They destroy plants and cost to replace landscaping is huge." Many people desire having a landscaped yard but cannot because of the deer. "I think that is a shame that I am prevented from landscaping because of the deer problem. I could spend thousands of dollars and hire a landscaping professional to come in and help me but I refuse to allow the deer to be the reason that forces me to do that. "

On the opposite side of the spectrum, many residents do not perceive landscaping issues as a problem in their life. These respondents claim that if residents plant the proper plants, then the deer will not eat their landscaping. "If people would simply use plants that deer don't eat in their landscaping there wouldn't be nearly as much complaining about the deer. I am way more concerned about things like jobs and transportation issues than any 'wildlife management' issue." To mitigate damage by deer, 15 respondents suggested that residents should plant non-palatable plants. Other respondents simply do not think landscaping issues are a problem in their lives.

Nothing in life is perfect. The deer add a thousand times more pleasure to the people of San Marcos than they add 'problems', and many 'problems' like having to make sure to plant native, deer-resistant landscaping is not a matter of having a 'problem'... it's a matter of being a responsible, compassionate, and educated citizen.

The landscaping issue is a good example of how respondents faced with the same situation feel differently toward the "problem" and deer. Some think deer eating landscaping is a problem while others do not.

At least 19 respondents expressed how the deer enhance their quality of life. Some of these responses were simple. "I love having the deer around. I ride a bike a lot and have no problems with them. Leave them alone." Other responses detailed how the deer enhance their lives. "The deer in San Marcos are a pleasant surprise every time I see them. San Marcos is a wonderful earthy city and I would hate to see less deer any day of the week." These respondents have no desire for any management and have few problems with the deer. "Although they sometimes feed on my landscaping, we did move into THEIR territory and I have educated myself on

deer-resistant plants... My family enjoys the deer and we think their presence enhances our home."

Some respondents have the exact opposite perception and view the local deer to be a hazard. "I went for a walk and a buck started approaching me in an aggressive manner." This can be frightening to anyone with no means to protect themselves. Deer can be dangerous in certain circumstances, posing risk to public health and safety. Other respondents in San Marcos have encountered deer in their yards and have had close encounters. "My visiting grandchild was almost hit by a deer who was racing around the corner of our house. It only missed him by a few feet. A very dangerous situation was fortunately avoided." Other respondents displayed concern for their health due to concerns of diseases in deer droppings and deer ticks. "One of our neighbors have (sic) been diagnosed with Lyme disease." At least 60 respondents left comments about concerns for their health or safety, ranging from deer-vehicle collisions, Lyme disease, or personal contact with deer.

Many interesting comments were made by respondents that did not necessarily fit into one of the above categories. A few respondents suggested solutions for the deer problem that would be difficult to implement. One respondent suggested the city spay and neuter all of the deer to prevent reproduction. Another respondent suggested putting contraceptive tablets in deer food, which again, is not possible because the technology does not exist.

Some respondents felt they were not educated enough on the subject to form an opinion. "I don't know if I am qualified to know the most effective technique." "I don't know" options were used for some questions in the survey, but not for preferred

management techniques. "I don't know my answer to 13 or 14 because I haven't heard both sides of the issue." "I don't feel I'm qualified to say whether there is an overabundance of deer nor proper methods to manage them." Many respondents felt that the city should educate the residents on the subject so they can make informed opinions. "Education is often/ always a major key." Others would like residents to be informed so they can make responsible decisions in their own lives.

People in San Marcos need to be educated to the fact that feeding the deer is not humane. Deer reproduce based on the amount of available forage. Giving the deer food encourages them to have more young. This is not fair to the deer and it is not fair to the property owners who are tired of the deer tearing up their yards.

Five respondents thanked the city for conducting the survey. Comments were short and simple. "Thanks for doing the survey" and "Thank you for posting the survey!" are two examples. Others thanked the city for "taking steps to manage the local deer." Others appreciated the city for "asking for my input."

Most respondents displayed strong emotions on these subjects, and some handled it with humor.

If someone opposes the sharpshooter program, they should be required to adopt a deer, pay for its relocation, and buy it a little jacket so it will be warm in the winter. They should also be required to bury it and pay for the damage to my car when I hit it in my neighborhood.

This respondent, although kidding, obviously feels strong about the subject. Other respondents joked that if residents choose to feed deer, they should also have to pay for shots and collars.

An interesting topic that was brought up by multiple respondents was how this controversy started. Apparently, the initial complaints to the city were made by two individuals who are new to the Willow Creek neighborhood. "The 2 people that have

started this insane movement had not lived here a year.” This has led many respondents to believe that it is only a handful of residents who are bothered by the deer and desire a reduction in herd sizes. "I think that the majority of people are not bothered by the deer... I believe that a few people have stirred up their neighbors about this.” These respondents seem to believe that only a few people are concerned about the deer situation.

I can't believe that this has come this far. Boy they were right when they said the squeaky wheel gets the job done. There are so many people that this involves our entire city and people excluding the couple that just moved to this community and started this that don't know about it.

These respondents do not perceive the urban deer as being a problem to the entire city, only "a handful of people who do not want to fence their yards.”

The majority of these respondents live in the Willow Creek neighborhood, where it appears this topic has created much controversy. Many respondents specifically mentioned Willow Creek in their "Additional Comments.” Responses varied on both sides of the spectrum, with each respondent telling their side of the story. "Too many deer in Willow Creek Estates because people are feeding the deer.” This Willow Creek resident obviously has a problem with the deer and with other residents' behaviors. Others perceive no problem with the deer being overabundant in this neighborhood. Some even cited the deer abundance as a reason for moving into the neighborhood.

EVERYONE I know LOVES the deer. I live in the Willow Creek Estates subdivision, where there are many deer, which is precisely the exact REASON WHY my husband and I purchased our home in Willow Creek and in San Marcos for that matter.

Still, some people see the abundance as being out of control. "Willow Creek is first and foremost a single family subdivision and not a wild animal preserve."

The entire content analysis is riddled with examples of how the residents in the city of San Marcos have no consensus on the subject of urban deer abundance and management. Many of the statements left in the "Additional Comments" portion of the survey were said with the utmost confidence, yet contradict one another. One respondent made an observation that does a great job of describing the scene in San Marcos:

The owner of Amkon feed store remarked one time, when I was purchasing coyote urine to try to discourage the herds of deer, that in San Marcos one resident on a street would come in to buy such products to drive the deer away, and their neighbor down the street would come in to buy deer food! It's a losing battle!

This can be seen through the content analysis; resident after resident disagreeing with one another on the deer situation. One last example shows how split the town is.

Two consecutive comments were made (Respondent # 148 and Respondent # 149) simply contradicting one another:

148. "Leave the deer alone!"

149. "Need to do something"

VI. DISCUSSION

How do interactions with deer influence residents' attitudes?

The results of the chi-square analysis are quite significant. With the exception of Lyme disease, associations were made for responses from all variables. The analysis produced 22 significant relationships between respondents' interactions with deer influencing their attitudes. These results are significant and numerous enough to accept the hypothesis that interactions with deer influence their attitudes toward urban deer population management. This information can be used in any management processes developed by the City of San Marcos. The role these data might play in the management process will be discussed in the Management Implications Chapter.

The majority of survey respondents perceive an overabundance of deer in San Marcos, believe that the deer cause problems, and desire a reduction in deer herd sizes. On the west side of I-35 in San Marcos, deer can be seen in yards and on roads in most neighborhoods. Most residents who commute to and from work in the mornings and evenings will more than likely see large deer herds in neighborhoods and undeveloped land surrounding the city. Seeing the deer this often make people very aware of the presence of deer.

Simply seeing the deer from time to time is not enough to conclude that the deer are overabundant and cause problems. As found from the results of this study, peoples' daily interactions with deer influence their opinion of deer. Respondents' negative attitudes toward the deer can partly be explained by the deer damaging their

landscapes, the inconvenience of constructing fencing to protect landscaping, and the fear of deer-vehicle collisions. When people have negative experiences with deer in their daily lives, they tend to have negative attitudes about them. The opposite was also found to be true. Respondents who feed the deer, or do not experience damage to landscaping and therefore do not have to use fencing, tend to have more positive attitudes toward the deer. These respondents do not believe the deer are a problem and do not desire any management.

It is curious that their hunting experiences had few influences on respondents' attitudes. Hunters are more likely to approve of lethal methods of management and are not too concerned about the humaneness of management. Those who have hunting experience are more familiar with how deer are killed and are not as emotionally moved by the process. Those who have not hunted before might be less familiar with the killing of animals and do not look forward to any such actions. This being said, one would think that hunting experience would have more influence on perceptions of overabundance, a desire for management, and one's overall attitude. This data suggests that hunting might not influence these much at all.

Respondents who experience no damage to their landscaping and those who feed the deer have more positive attitudes about deer, which is reflected in their attitudes about management. Those with positive attitudes toward local deer are less likely to desire any management. These respondents would not support a new law banning the feeding of deer. This is because half of them feed the deer themselves and would not desire any law stripping them of their deer viewing privileges. A few of these respondents do not believe that city has the right to ban feeding. One

respondent claimed that "If we want to feed the deer on our property which we pay the taxes on, no one should infringe upon our right to do so." Respondents who have positive attitudes toward the deer are also more concerned with how humane any management conducted in the city would be. These respondents were far more likely to desire humane management and were less likely to approve of any lethal methods.

Respondents who constantly experience damage to their property or are forced to put up fencing tend to have more negative attitudes toward the deer. The majority of respondents believe the deer cause problems and they want them managed. This is why the survey was conducted in the first place, because residents throughout the city have complained about deer. So how do these negative interactions influence attitudes? Damage to landscaping seems to be the most important variable in this study because it influenced every "Attitude" variable. Those who experience landscape damage want management no matter the cost because they think there are too many deer and they cause problems. These respondents are not concerned about the cost or humaneness of management, only the effectiveness. The researcher believes this is because these are the people who are experiencing substantial financial losses and they want the problem to be solved.

The results from this study suggest that attitudes are likely to be based on legitimate concerns from respondents' daily lives, not only from what they have read in the newspapers or have discussed with neighbors. As discussed in Attitude-to-Behavioral Process Models, the accessibility of an experience highly influences one's attitude and subsequent behavior. This data further validates Attitude-to-Behavioral Process Modeling, because respondents' "accessibility" to deer experiences were

highly likely to influence their attitudes. Residents who view deer under their backyard feeders everyday are very likely to have a strong positive attitude about the deer. Those who experience damage to their landscaping or fear deer-vehicle collisions are more likely to have negative attitudes toward the deer. These examples are due to the high "accessibility" to deer experiences, whether these experiences are positive or negative. Respondents who have fewer interactions with deer are more likely to have less passionate and more varying attitudes. Therefore, we can conclude residents' attitudes are strongly influenced by the accessibility of daily deer interactions.

The data suggest that managers using the Attitude-to-Behavioral Process Model to predict community behaviors toward urban wildlife management might consider also analyzing community interactions with wildlife to help create the model. This study concludes that daily interactions with deer highly influences attitudes. ABP models depend on "attitude accessibility" to predict how a community will behave. Attitudes have more influence on behavior when there is a higher degree of "attitude accessibility". In regards to urban deer management, a strong example of "attitude accessibility" is the amount of daily interaction people have with deer. When building models to predict behavior, managers can use these interactions to gauge a community's "attitude accessibility", which might strengthen the model success and applicability.

Individuals' personal values also play a role in influencing attitudes (Hitlin and Piliavin 2004), but this survey did not ask questions regarding personal values. Values focus more on ideals while attitudes are more applied evaluations of an object.

Therefore, attitudes were more easily evaluated in a survey of this scope. To study respondents' values on this subject, a greater in-depth survey would be needed. However, personal values play a very large role in influencing one's attitude. This topic can be emotional, especially considering how each person can have many different values. Some respondents mentioned that they value the life of the deer and hold that above all else. Others might value the aesthetics of their home and are not concerned with how the deer are managed. Without inferring too much from the qualitative analysis, it can be concluded that many people in San Marcos have very different values in regards to the topic of managing urban deer.

Social norms also play a large role in how people evaluate an attitude object (Hitlin and Piliavin 2004). If an individual is surrounded by friends and family who value the presence of deer in the neighborhoods, then it is likely that they will have a more positive attitude toward preserving the deer. If someone grew up hunting with their friends and family, they might be more likely to perceive bow-hunting as a humane management technique, and be less likely to be concerned with the humaneness of any management. However, it is unclear how, or if, respondents were operating under normative pressures during this survey.

Spatial Analysis

Few spatial patterns were discovered for the variable responses. Respondents' perceptions and attitudes vary little across San Marcos with few exceptions. Why were there not more patterns? One reason might be due to the low response rate for residents living on the east and south sides of the city. Although this is a pattern in

itself, more patterns might have been generated had the sampled population varied more spatially. There are a few spatial patterns that are worth exploring, as discussed below.

Cluster Analysis

Respondents' locations were randomly distributed across San Marcos, with the exception of Willow Creek residents. This is the only location that demonstrated any clustering. Locations for all of the variable responses were randomly distributed. This means that even if many respondents live close to one another, they have a random collection of differing opinions. No single area produced one type of attitude compared to another area with a completely differing view. The exception to this is Willow Creek. Respondents' locations are clustered very densely in Willow Creek. This is due to a high response rate of 226 residents from this neighborhood. Why would so many people from one neighborhood take this survey? An explanation for this might have been found in the content analysis. Many Willow Creek respondents left very emotional comments ranging on both sides of the spectrum. Many residents in Willow Creek are outraged by the number of deer and associated damage to landscaping and risk of deer-vehicle collisions. Although the majority of residents perceive an overabundance, many residents are outraged that deer management is even being considered. The content analysis discovered that the urban deer topic has stirred up much controversy in Willow Creek, which might have invited more involvement, leading to a high response rate.

The cluster analysis did demonstrate clustering for most variable responses within Willow Creek. This, however, is not significant because clustering was

present for all responses, with the exception of those who experience landscape damage. Clustering was demonstrated for all responses because there is such a high density of respondents in Willow Creek. The analysis did not demonstrate clustering for those who experience damage to landscaping. Why would this vary so much in one neighborhood? Why do next-door neighbors experience different levels of damage to landscaping? There is no way of knowing from the questions used in this survey, but the content analysis hints at home explanations. Many respondents in Willow Creek claim to use landscaping plants that are less palatable for deer. In fact, these respondents were likely to suggest that the City of San Marcos educate the community about planting certain native plants that deer do not eat as much. These respondents are less likely to experience damage to their landscaping because the deer only eat these plants under severe conditions. Some residents might not be aware of different plant options or choose to ignore this approach because of their desire for ornamental landscaping. Some respondents claimed to refuse to select their plants because of the deer. They would rather the deer be removed than to have to be limited in their plant selection. This might explain the variance of damage to landscaping within the Willow Creek neighborhood, and San Marcos in general.

Proximity to Deer Habitat

Severe damage to landscaping by deer is a good indication of deer overabundance. This variable reflects actual physical evidence of deer presence as opposed to a respondent's perception of overabundance. Respondents who experience severe damage to their landscaping or property by the deer tend to live near greenspaces, undeveloped land, or in Willow Creek. These respondents have

one thing in common; they are surrounded by deer habitat. Although many deer bed down or sleep in yards throughout the city, the majority of deer in San Marcos bed down in greenspaces and undeveloped land bordering the neighborhoods. San Marcos has an abundance of greenspaces and undeveloped lots spread throughout the area, creating a very accommodating environment for urban deer. These greenspaces contain a variety of habitats ranging from oak savannahs, juniper thickets, grass lands, and creek and river bottoms. Many deer in San Marcos will live in these greenspaces and undeveloped lands and enter neighborhoods to browse on natural forbs and ornamental landscaping. This might explain why respondents living on the borders of the greenspaces are experiencing severe damage to their landscaping. Although it does happen, urban deer in San Marcos are less likely to venture too far into the urban landscape without a patch of wooded protection nearby. Few deer are observed in downtown San Marcos, which provides little natural cover for deer.

Willow Creek, on the other hand, is virtually surrounded by wildland environments, whether they are greenspaces or undeveloped rural land. The neighborhood is also characterized by large acreage lots, many of which provide shelter and screening where deer hide. Other yards have deer feeders to invite the deer closer into the neighborhood. The deer feel comfortable in the neighborhood and many residents claim the deer have become domesticated to humans. This might help partly explain why residents experience such severe damage to landscaping, because the neighborhood is inviting to deer living in the surrounding wildland environments.

These data suggest that, to some degree, respondents' locations influence their attitudes toward deer population management. Residents who live near the different deer habitats in San Marcos experience more severe damage to their landscaping. Since damage to one's landscape, or lack of damage, influences residents' attitudes, location may have an effect on attitudes.

Neighborhood Analysis

The majority of respondents living in Willow Creek and Spring Lake Hills perceive an overabundance of deer in San Marcos and desire a reduction in the population. As previously discussed, Willow Creek is surrounded by greenspaces and wildland environments. The north and west sides of Spring Lake Hills are bordered by the 251 acre Spring Lake Preserve. This neighborhood is also not very dense and many residents have large lots of land. Numerous large deer herds can be observed daily in both of these neighborhoods. These deer herds are largely due to the neighborhoods' proximity to greenspaces and wildland environments. Residents in these neighborhoods have constant daily interactions with urban deer, and these interactions might influence their attitudes

The majority of respondents living in Westover do not perceive an overabundance of deer and do not desire a reduction. Almost 60 percent of these respondents do not believe the deer cause enough problems to warrant management. Why are attitudes in this neighborhood different from the other two neighborhoods? The neighborhood's location and deer abundance might influence these attitudes. Westover is only bordered on the southwest side by greenspace, and although deer can be seen occasionally, there are not large herds. Small groups of deer rarely

wander into this neighborhood, and seldom do they wander far from the greenspace. More respondents from Westover answered that they receive "No Damage" than those who answered "Moderate Damage" and "Severe Damage" combined. Westover residents' attitudes are probably more positive than Willow Creek and Spring Lake Hills residents because they have fewer negative daily interactions with deer, due to their proximity to more urban development than greenspace.

Only 13 people residing on the east side of I-35 responded to the survey. Why would so few residents from neighborhoods on the east and south sides of San Marcos take this survey? This low response rate begs for further research. Even if there are fewer deer in the prairie biome of these areas, surely residents would still be concerned about city management and tax dollars spent. Another question is if there are much fewer deer on this side of town, why did the majority of respondents in these areas perceive an overabundance of deer and desire management? There were too few responses and too geographically dispersed to attempt to answer this question.

The last significant spatial pattern found was that 38 Willow Creek respondents claim to feed the deer. Why would so many people in one neighborhood feed the deer? The proper questions were not asked in this survey to answer this question; however, this information has implications for other questions in this study. The abundance of deer in Willow Creek has been explained in part by the neighborhood's proximity to greenspaces and wildland environments. Feeders can also help explain this abundance. The deer in Willow Creek can be observed daily taking advantage of these feeders, which attract deer living around the neighborhood.

Feeders can also help explain some damage to property and landscaping. Many residents complained that their landscaping is being damaged because their neighbors in Willow Creek feed the deer. The deer show up regularly when the feeders go off, eat all of the corn, and then continue to browse in the surrounding yards. This process helps explain the volume of respondents in Willow Creek who experience severe damage to their landscaping, which in turn influences their attitudes.

Consensus

There seems to be little consensus among San Marcos residents on the topic of urban deer management. Respondents did agree that the deer cause problems in the city, but were split on whether or not these problems are worthy of official management. The majority of respondents experience damage to their property or landscaping, which probably explains why there is consensus on the deer causing problems in San Marcos. Also, the concern for deer-vehicle collisions, as documented in the content analysis, might also help explain the consensus on deer causing problems. Some might not think the problems are serious enough to warrant management, while others simply do not want the deer being harmed. Also, residents agreed that if any management did occur, the effectiveness of the management technique should be a concern of residents. This makes sense because what use would management be if it was not effective? Other than these two subjects, there was no consensus for the San Marcos community.

Why would a community be so divided on a subject? Respondents' attitudes were nowhere near consensus. One explanation for this might be that different

residents experience different interactions with deer. This study concludes that residents' interactions with deer influence their attitudes toward deer and population management. The spatial analysis shows that different residents have very different interactions with deer. Some people experience severe damage to their landscaping, some residents are forced to use fencing to protect their property, and yet others have no negative experiences with the deer. People have these experiences randomly across town with few patterns emerging. This is explained in part by proximity to greenspace, and in part due to choice of landscaping plants. Next door neighbors are experiencing completely different interactions. These interactions with deer influence how people view this topic. These different daily interactions, combined with personal values, create a broad spectrum of attitudes that seem to conflict for this topic in San Marcos, as seen in Figure 26.

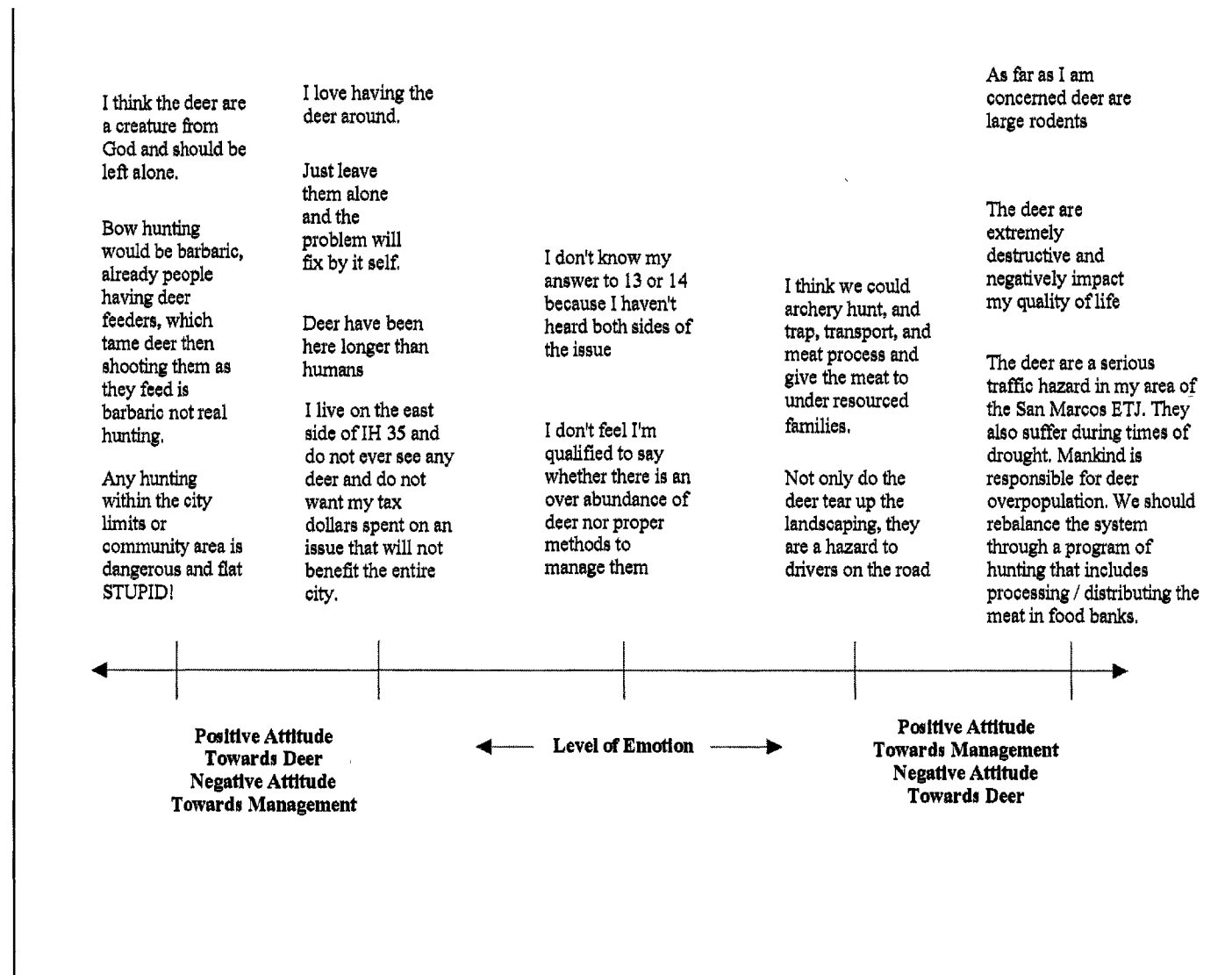


Figure 26. Emotional Spectrum of Respondents.

VII. MANAGEMENT IMPLICATIONS

As documented in the literature review, there is something of a consensus among wildlife managers regarding management of urban deer populations – namely that herd sizes be reduced by skillful and humane harvesting. However, as reflected in the literature and documented in this study, there is little consensus among urban populations regarding deer. Thus, this section of this study attempts to reconcile the recommendations of the wildlife management literature with the reality of the diverse perceptions and attitudes of the respondents to this survey of the San Marcos area.

The situation in San Marcos is that the majority of people are experiencing damage to their landscaping and half of the people are forced to take precautions to mitigate this damage. Although not quantified through this survey, many residents have either struck deer with vehicles or fear deer-vehicle collisions. These interactions have created a category of people who have negative attitudes toward the deer. How are these negative attitudes changed? Can changing peoples' interactions with deer produce positive attitudes? How could these interactions be changed? There are ways to modify human-deer interactions such as planting non-palatable plants and posting deer-crossing signs on roads. The only problem is some people prefer to have ornamental shrubs and may not wish to make a compromise. Also, many officials claim that road signs have not been effective in reducing deer-vehicle collisions.

An answer to how interactions can be changed is possibly through population management of the deer. A slight majority of respondents (56.7 percent), approved of the city managing the local urban deer populations. The literature review concluded that urban deer management can drastically reduce the amount of deer-vehicle collisions and damage to landscaping. Studies have also shown that community perceptions toward deer become more positive after a herd has been managed and reduced. This data, combined with the fact that there is consensus among residents that the deer do cause problems, might warrant a city-wide management program. Although the majority of respondents would support management, residents would still lack a consensus for management type. Although respondents highly disagree on preferred management type, the majority of residents would support lethal methods. This might relieve managers, because although many residents will not see their preferred management option used, the community is not completely against killing some deer. This gives local managers some flexibility when choosing management options.

The majority of respondents, 58 percent, believe bow-hunting is a humane deer management tool and many respondents displayed support for it in their "Additional Comments." As mentioned before, the majority also approve of using lethal methods for management. As suggested by the literature review, bow-hunting can be a safe, effective, and humane approach to managing urban deer. In an interview with Mr. Bert Stratemann, he mentioned that the Texas Parks and Wildlife Department suggested bow-hunting as a viable option for San Marcos. The agency could provide the city with deer hunting tags, close off some of the greenspaces, and

hold hunts by qualified volunteers. By dramatically reducing the deer populations in the greenspaces, less pressure would be put on the browsing vegetation, inviting deer out of the neighborhoods back into the greenspaces. Although this is not the only viable solution for the city, it is one that should be considered and further researched.

The majority of respondents would support a new law banning feeders within the city limits. This might be a great opportunity for city managers to reduce problems with human-deer interactions. The literature provided great support for communities initializing a ban for feeders. Feeding deer mechanically with feeders within urban environments creates large congregations of deer on a daily basis, which has destructive consequences. The large herds can demolish surrounding landscaping, pose a threat with deer-vehicle collisions, and can create aggressive deer, especially during mating seasons. Many researchers have studied the effects of these large congregations of urban deer, and the majority of these researchers, in this literature review, suggest that banning corn feeders is a useful way to reduce human-deer problems. Even if this is true, many residents will be extremely offended by this suggestion, since many respondents claimed that it is their right to feed the deer and no one should infringe on that.

Although the majority of respondents desire management due to the problems of overabundance, a majority does not mean consensus. Only 30 percent of respondents do not believe there is a problem and 43 percent do not desire any management. Although the majority feels one way on this subject, managers will be faced with public dissent from residents. This topic is emotional enough to produce public protest for population management, no matter the type.

Adaptive management might be the most suitable approach for a situation as emotional as the urban deer situation in San Marcos. Not only is adaptive management efficient in a management sense, it is also geared toward pleasing a wider audience. Local managers might have a better chance at reaching consensus if a multi-step adaptive management approach is used. Educating the public on deer biology and deer population management would be an obvious start. Many respondents are uneducated on deer biology and how to deal with overabundances, as indicated by the qualitative analysis. Some respondents claimed to not know enough about the subject to decide if there are too many deer, or to know which management option would be the most suitable. Educating the public will allow residents to have sound opinions. For example, the content analysis documents that many residents believe the deer "were here first" and that humans moved into their home, but historical research shows this is not the truth. White-tailed deer were never abundant in the Texas Hill Country or on the plains below. It was not until humans altered the eco-regions through the suppression of wild fires and elimination of the screw worm and natural predators that deer adapted to flourish so well. As mentioned in the literature review, humans then built urban environments that provide deer with year-round watered and fertilized food for the deer (Fulbright and Ortega 2006). The deer populations were actually very low in the San Marcos area, and it was not until the 1970s that deer populations began to rise here. It is because of human alterations to the environment that deer have become so abundant, and some believe we have a sense of responsibility now to act responsibly and make sure deer are not starving to

death or being hit by vehicles in mass volume. If residents were educated on the history of local deer, their perceptions might change.

The literature review suggests that educating a community on deer biology is a very important step in any management process. It is important for a community to know about deer biology in order to make informed decisions. For example, many people do not know that deer overabundances can lead to deer starving to death, dying of disease, or being hit by vehicles. It is also important for residents to know the kinds of effects overabundant deer herds have on the landscape. Studies have suggested that overabundant deer herds are the number one reason for the rarity of oak saplings on the Edwards Plateau. Overabundant deer herds put intense browsing pressures on saplings, reducing the number of oak trees and other species on the landscape. This can be seen clearly in San Marcos for there were intense browse lines in the greenspaces during the 2009 drought. The literature also suggests that the community be educated on the effects corn feeders can have on urban deer herds. As mentioned before, feeders create large congregations of deer herds, which in turn contributes to the transmission of diseases. Corn feeders can also help sustain otherwise non-sustainable herds by feeding them when there is not enough food on the landscape. A few respondents mentioned that they only feed the deer during the droughts so that the deer do not starve. The literature suggests that this only makes the situation worse because it unnaturally allows deer to live longer during a hard time.

Residents who participated in this survey were asked for their preferred management option and which management option is most effective. These

responses illustrate that many respondents were not educated on these options. For example, a few respondents left comments concerning the efficiency, safety, and humaneness of bow-hunting. They were concerned that bow-hunting is not efficient enough to produce high kill rates or that bow-hunting does not provide a quick humane death. Many seemed concerned about the safety of bow-hunting, citing fears of humans or pets being injured by arrows. The literature review suggests that bow-hunting is a safe, humane, and effective means for managing urban deer. Another example showing how respondents might be uneducated about deer management techniques is the question "Which management option do you perceive to be most effective?" A total of 17.5 percent of respondents believe that taking no action at all is the most effective way to manage deer populations. This is not the case, because this is the current policy in San Marcos and the deer are perceived as causing problems.

An education program can also address mitigation techniques that residents can use in their daily lives. These solutions include planting proper non-palatable plants and citing the destructive consequences of using corn feeders in an urban environment. An educational program would allow residents to make more informed decisions.

After implementing an educational program, a follow up survey might produce results with more of a consensus. The literature concluded that educating a community changes perceptions and attitudes toward deer. For example, respondents might have preferred the "Trap and Release to Another Location" option for management because it seems like a humane method. This option might have been

chosen without the respondent knowing that this method results in a very high mortality rate for the released deer. If the community was educated on the different options, the results would probably differ and desired outcomes might change. Educating a community with a follow-up survey is a good approach for managers to reach a better consensus.

By analyzing these results, managers may be able to proceed with a management option or no management, in an experimental context. Residents might be accepting of managers who find what works for their specific location and then adjusts to any short-comings. Wildlife management is rarely a quick process with few decisions. Adaptive management requires managers to try techniques and then adapt the techniques to new data and findings. The urban deer scenario in San Marcos would be no different. No one-time solution would reduce the deer populations forever or please all residents; it will more than likely take a series of experimental approaches. As suggested by a few respondents, maybe a combination of management options would work more efficiently and please a wider audience than selecting only one management option. After any management technique has been conducted in the city, again, another follow-up survey would be useful to managers. Studies have shown that attitudes and perceptions often change after some management method has been conducted. A follow-up survey can quantify any changes in the community's attitudes and can also be used to determine the level of success of the management. If the purpose of management is to please the community, then this follow-up survey can determine if the community's desired outcomes were reached. Again, adaptive management calls for management to be

used in an experimental context. Managers can use the follow-up survey to see if the management was successful and, if not, determine new possible routes.

Attitude-to-Behavioral Process Modeling could be used by managers to predict how local residents might respond to different management options. Local managers will undoubtedly want to take into consideration how residents will behave toward any decisions, and the findings from this study could help make these decisions. This study concludes that respondents have high accessibility to deer experiences, which can be used to link attitudes to behavior. This process is beyond the scope of this study, but managers can use this data for such predictions. For example, residents who feed the deer and have positive attitudes about them, may be expected to protest any management. Educating the public and then following up with another survey would be even more productive in predicting behaviors toward management.

No matter what management plan is chosen, managers are encouraged to work with the community in a timely fashion to try to reach a consensus and please residents. A few respondents displayed a desire for a swift response to this problem. Respondents did not want this process to drag out over multiple years with nothing being accomplished. As one respondent puts it, " Hopefully, this matter will be addressed rather than talk it to death." The literature also warns managers of having management programs being held hostage by special interests or a lack of 100 percent consensus. One hundred percent consensus is rare and near impossible to accomplish.

VIII. CONCLUSIONS

This study concludes that the local cultural carrying capacity for urban deer has been reached, as indicated by severe damage to landscaping and respondent perceptions and attitudes. A majority of respondents perceive an overabundance of deer and believe the deer cause problems. Large deer herds can be seen in many neighborhoods on a daily basis. Many residents are no longer tolerant of deer damaging their landscaping, while others live in fear of deer-vehicle collisions. Before this study was conducted, petitions had already been signed and submitted to the City, requesting an immediate reduction in the deer population. In light of the data produced by this study and the afore-mentioned petition, it is clear that deer are causing problems in San Marcos.

Although the majority of residents that responded to this survey desire management for the deer, there is not a consensus on the subject of *how* they should be managed. Many residents have strong emotions regarding the treatment of the deer, and a simple "majority rules" approach will not appeal to the community. If city officials propose a management technique, there will more than likely be dissent from many parts of the community.

The results of this study can assist local managers in decision-making regarding urban deer management. It will be useful for managers to know that the majority of respondents perceive the deer to be overabundant and cause problems, and that slightly more than half of the residents support lethal methods for

management. However, a substantial percentage (43.3 %) of residents do not desire any management and officials should take this into consideration when making decisions. Managers might use these data to define an optimum carrying capacity, which is an equilibrium between residents on all sides of the spectrum. That would mean identifying a deer population size on which a consensus could be reached.

This study also concludes that residents' daily interactions with deer strongly influence their attitudes toward deer abundance and population management. Residents who have positive experiences with deer are more likely to have positive attitudes toward the deer. Residents who have negative experiences with deer, such as damage to landscaping or deer-vehicle collisions, are more likely to have negative attitudes toward an overabundance of deer. Although these interactions strongly influence perceptions and attitudes, they are not the only cause of attitudes, but are simply one aspect of influence. Individuals' personal values and social norms also influence attitudes.

This study can assist in refining Attitude-to-Behavioral Process Models that seek to predict how a community will behave toward urban wildlife management decisions. This study suggests that accounting for daily interactions with wildlife might help strengthen models and add to the success in predicting behaviors.

Data from this study suggest that residents' proximity to greenspaces and wildland environments is related to severe damage to landscaping and property by deer. The majority of respondents who experience severe damage to landscaping live near open land that provides deer habitat. The deer make daily rounds from these

greenspaces into neighborhoods for water, forbs, ornamental shrubs, and corn provided by residents.

Based on the surveys received, attitudes varied very little across San Marcos. However, few residents living in the southern and eastern parts of the city participated in this survey. A higher response rate from those areas would produce a more accurate description of residents' perceptions. Although there was not much consensus among San Marcos residents on the topic of deer management, the literature suggests that managers are encouraged to work swiftly and diligently to find a solution to this problem. Residents have made requests that this process not drag out for a long time, especially if it is not producing results. The literature also warns managers that programs can be taken hostage by special interests and communities that do not completely agree on the decisions; therefore, it is imperative that City and staff address the subject of deer management before they lose support they have for action at this time.

IX. FUTURE STUDIES

This study has identified future research topics. It is important to know why there was such a low response rate for residents residing on the east and south sides of San Marcos. Determining the cause of this low response rate, and then conducting another survey that gets more respondents from these neighborhoods would be beneficial to city managers. Overall, this would produce better results in understanding the attitudes and perceptions of all San Marcos residents.

The data of this study can be used to predict possible behaviors by San Marcos residents and would be helpful in making any decisions. An analysis of the Attitude-to-Behavior Process Models can predict how residents might react to the different management options available, which can then be used to decide on specific models. Deer management is an emotional topic in San Marcos and there will be dissent in regard to certain management options. Using a more detailed Attitude-to-Behavior analysis, managers can make educated decisions based on how residents might react.

The findings of this study suggest that an educational program and a follow-up survey(s) be implemented by the City. Numerous concerns related to deer management were addressed in the "Additional Comments" portion of the survey. City officials can base an educational program and follow-up survey(s) on these concerns. One suggestion is to have the follow-up survey ask questions that address residents' values regarding the urban deer situation. The literature cites numerous

studies where attitudes change after an educational program is conducted. If the City decides to conduct an educational program on deer biology and management options for the community, a follow-up survey could be used to understand how perceptions and attitudes have changed and quantify these changes to determine the community's desires.

APPENDIX A

SURVEY

Survey Questions

- 1) Are you a resident of the City of San Marcos city limits?
A) Yes B) No
- 2) Do you believe there is an over-abundance of white-tailed deer within the city limits of San Marcos?
A) Yes B) No C) Don't Know
- 3) Do you believe actions need to be taken to reduce the deer population?
A) Yes B) No C) Don't Know
- 4) Which statement best fits your attitude toward our local white-tailed deer populations?
A) The deer do not cause any problems in San Marcos
B) The deer cause some problems, but not enough to worry about
C) The deer cause many problems and solutions are needed
- 5) Has a physician diagnosed you or anyone in your household with Lyme disease in recent years?
A) Yes B) No
- 6) Do you experience damage to your landscaping?
A) No B) Moderate Damage C) Severe Damage
- 7) Do you use fencing or other repellents to protect your landscaping?
A) Yes B) No
- 8) Do you feed the deer with corn or any other supplements?
A) Yes B) No
- 9) Would you support a new city law banning residents from feeding the deer in San Marcos?
A) Yes B) No C) Don't Know
- 10) Do you think the city should create a Citizen Task Force of stakeholders to recommend deer management techniques to the city?
A) Yes B) No C) Don't Know

11) Do you believe bow-hunting to be a humane management tool?

A) Yes B) No C) Don't Know

12) What are your concerns regarding the results of any deer management conducted in San Marcos? Please rank your answer as follows. 1= not concerned, 5 = very concerned

A) Cost 1 2 3 4 5

B) Humaneness 1 2 3 4 5

C) Effectiveness 1 2 3 4 5

13) Have you ever hunted deer?

A) Yes B) No

14) What deer management technique would you most prefer?

A) Trap and Release to Another Location

B) Trap, Transport, and Process Meat

C) Archery Hunts by Qualified Volunteers

D) Tranquilize and Euthanasia

E) Hire Sharpshooters

F) Reintroduce Natural Predators

G) Take No Action

15) Which deer management technique do you perceive to be most effective?

A) Trap and Release to Another Location

B) Trap, Transport, and Process Meat

C) Archery Hunts by Qualified Volunteers

D) Tranquilize and Euthanasia

E) Hire Sharpshooters

F) Reintroduce Natural Predators

G) Take No Action

16) Your Sex?

A) Male B) Female

17) Your Age?

A) 21 and Under

B) 22 to 34

C) 35 to 44

D) 45 to 54

E) 55 to 64

F) 65 and over

18) Are you a property owner in San Marcos?

A) Yes B) No

19) What is the nearest street intersection to your house? _____

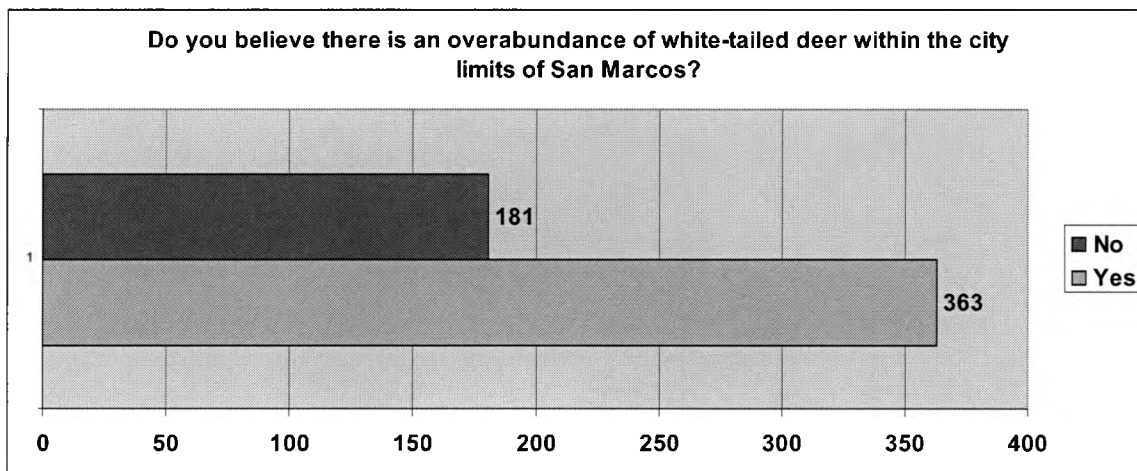
Additional Comments Box

APPENDIX B
SURVEY RESULTS

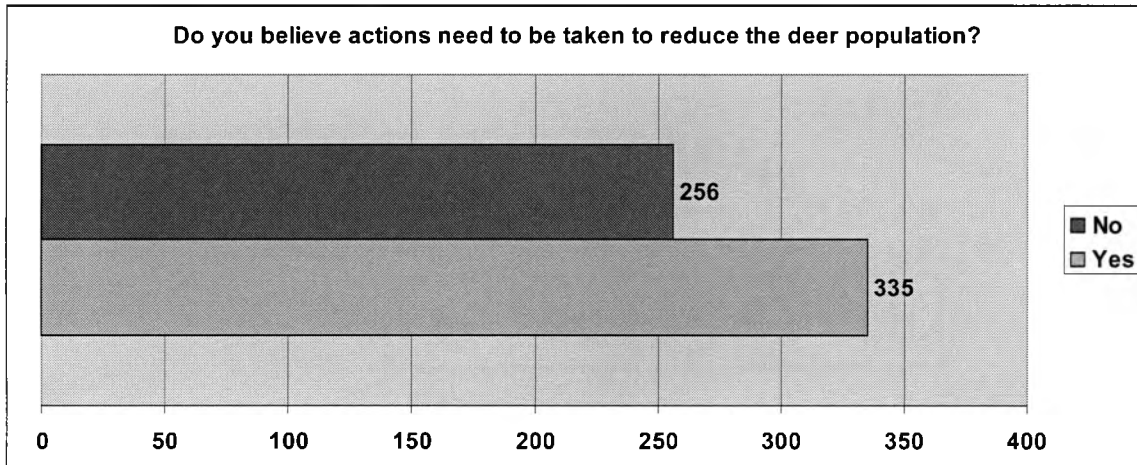
1) Are you a resident of the City of San Marcos city limits?

Yes	78.6%	497
No	21.4%	135

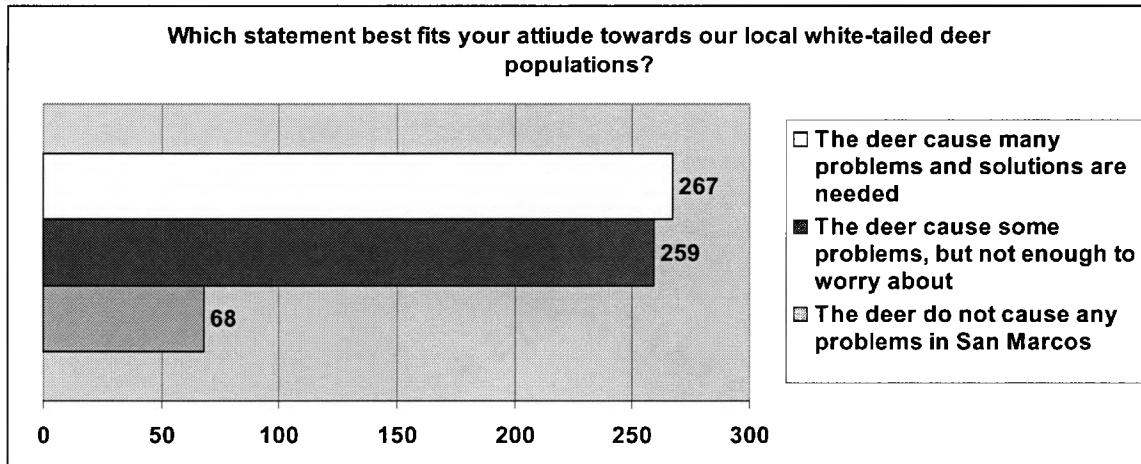
2) Do you believe there is an over-abundance of white-tailed deer within the city limits of San Marcos?



3) Do you believe actions need to be taken to reduce the deer population?



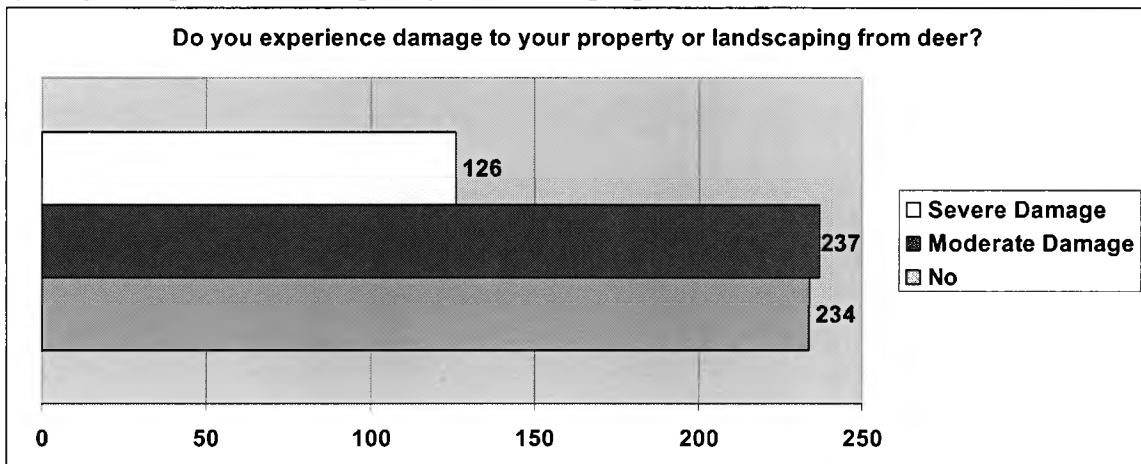
4) Which statement best fits your attitude toward our local white-tailed deer populations?



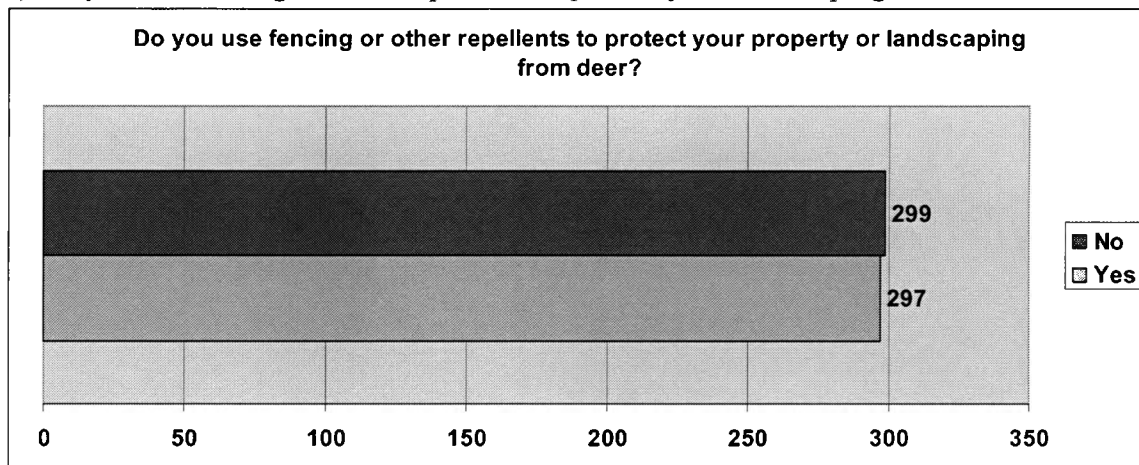
5) Has a physician diagnosed you or anyone in your household with Lyme disease in recent years?

Yes	1.7%	11
No	98.3%	623

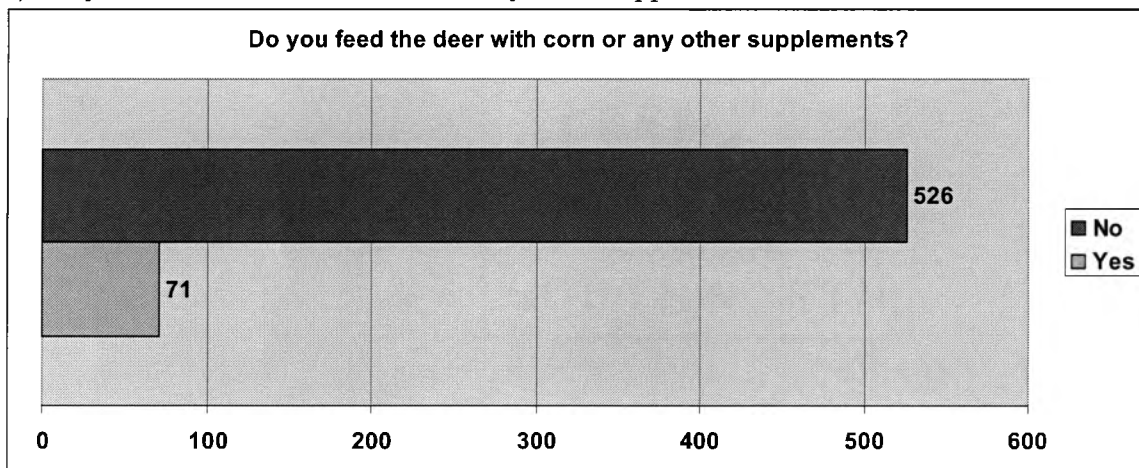
6) Do you experience damage to your landscaping?



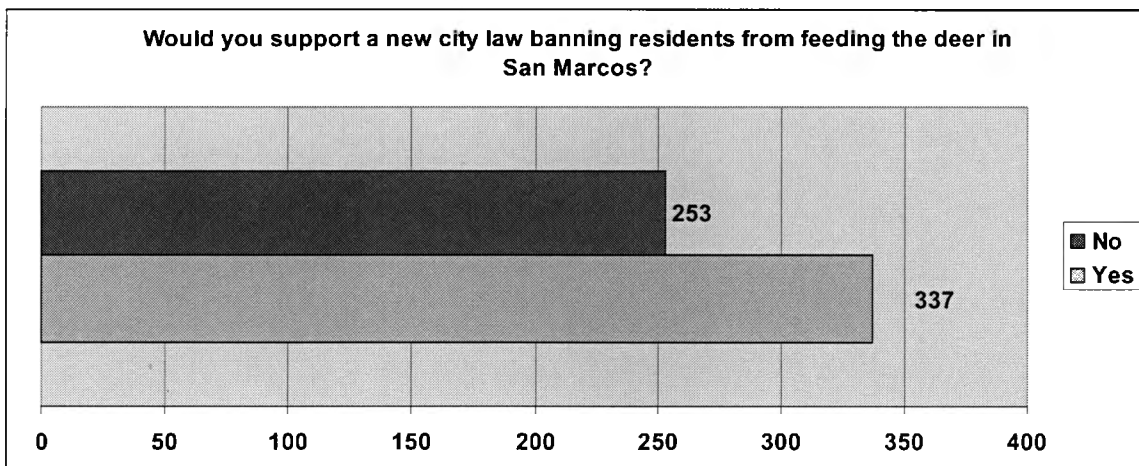
7) Do you use fencing or other repellents to protect your property or landscaping from deer?



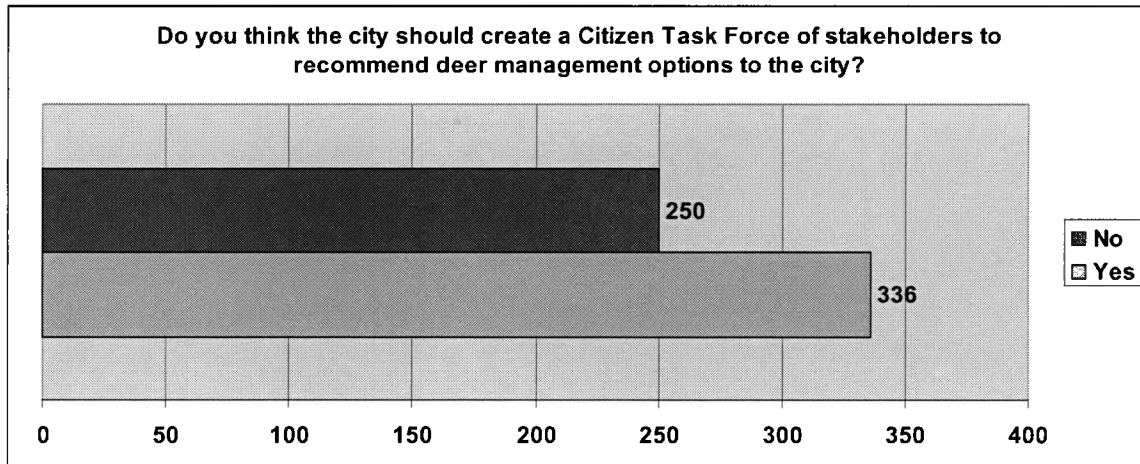
8) Do you feed the deer with corn or any other supplements?



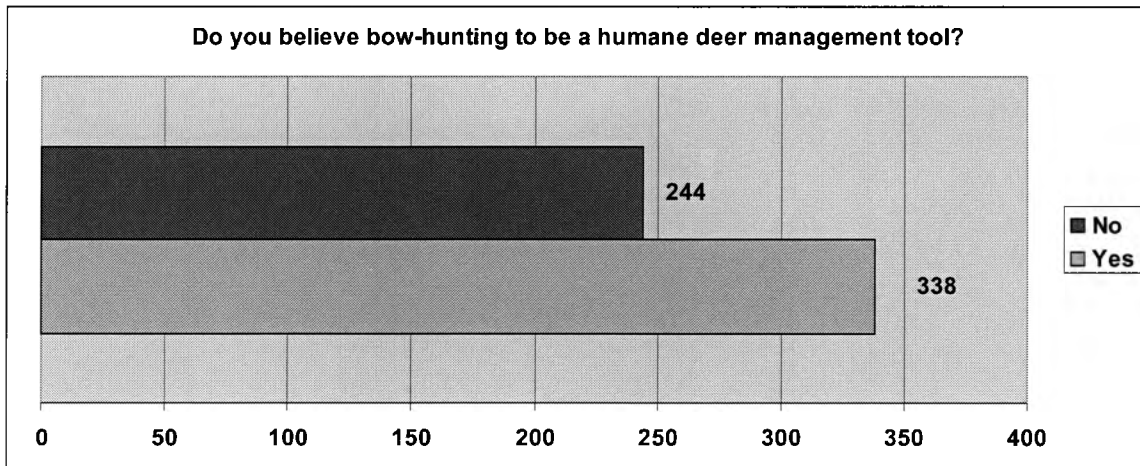
9) Would you support a new city law banning residents from feeding the deer in San Marcos?



10) Do you think the city should create a Citizen Task Force of stakeholders to recommend deer management techniques to the city?



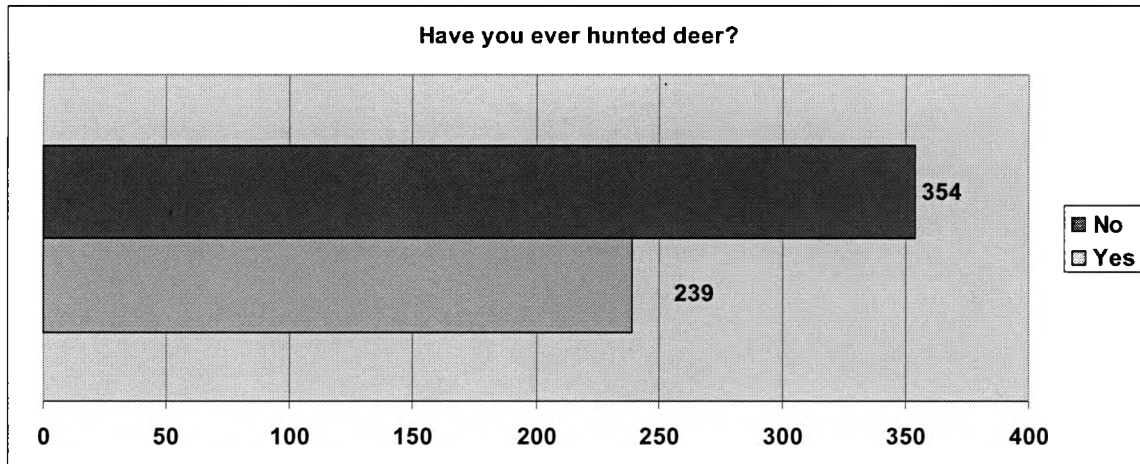
11) Do you believe bow-hunting to be a humane management tool?



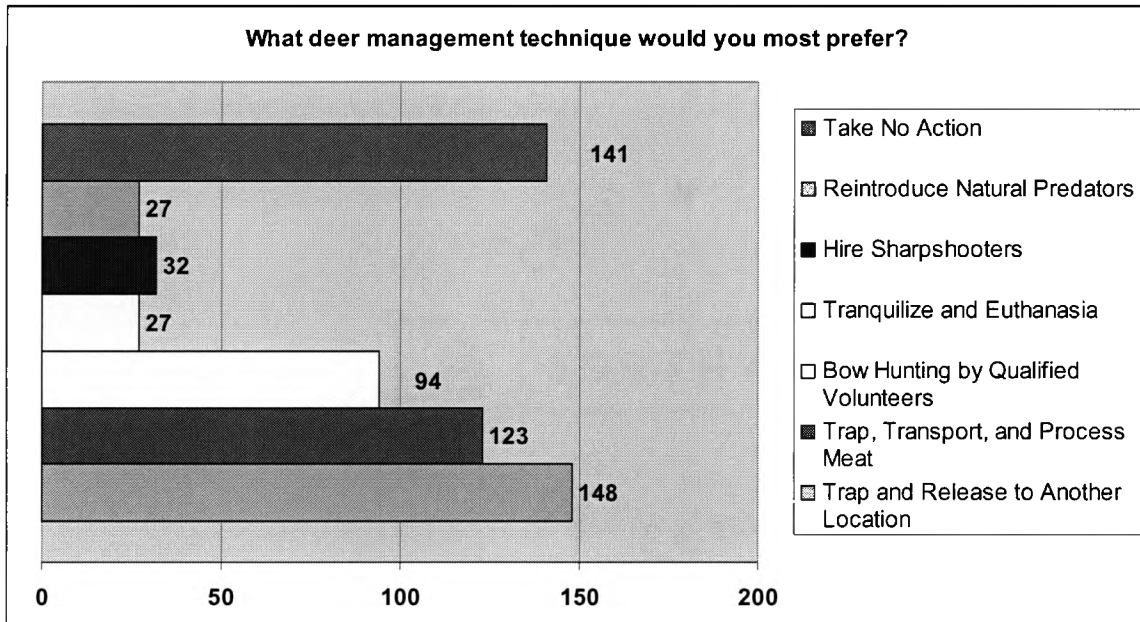
12) What are your concerns regarding the results of any deer management conducted in San Marcos? Please rank your answer as follows. 1= not concerned, 5 = very concerned

	Not Concerned	Rarely Concerned	Neutral	Somewhat Concerned	Very Concerned	Rating Average	Response Count
Cost	82	29	106	181	188	3.62	586
Humaneness	89	33	74	142	250	3.73	588
Effectiveness	18	8	63	169	325	4.33	583

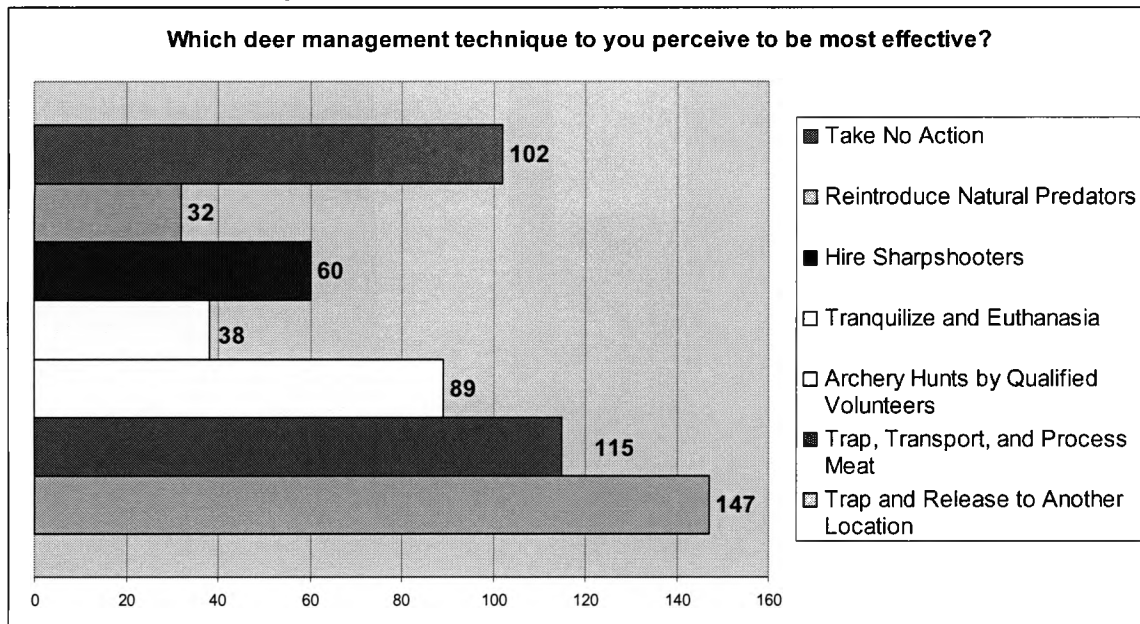
13) Have you ever hunted deer?



14) What deer management technique would you most prefer?



15) Which deer management technique do you perceive to be most effective?



16) Your Sex?

Male	Female	Response Count
310	317	627
49.4%	50.6%	

17) Your Age?

Age	21 and Under	22 to 34	35 to 44	45 to 54	55 to 64	65 and over	Rating Average	Response Count
	15	126	98	131	152	111	3.97	633
	2.4%	19.9%	15.5%	20.7%	24.0%	17.5%		

18) Are you a property owner in San Marcos?

Yes	73.8%	468
No	26.2%	166

19) What is the nearest street intersection to your house? 604 Responses

Additional Comments Box

326 Responses

APPENDIX C

ADDITIONAL COMMENTS PRESENTED IN STUDY

- "There are hungry people in our city that could benefit from having the meat processed for food"
- "I'd favor both Trap and Release and Archery Hunts, especially if the meat is donated."
- "Bon Tons Meat Market! The FHFH program pays for the processing, so it helps to eliminate the over population and also helps the food banks and helping hands programs feed the hungry."
- "The deer were here first. Live with it."
- "The deer were here first, and we all knew that fact when we bought our homes. Those who don't like deer are more than welcome to leave."
- "Initialize a permit system for qualified archers to humanely harvest the deer."
- "Allow hunters to hunt in city limits during deer season. Give the meat to the poor."
- "I believe that the humane death of animals can be accomplished through shooting (skilled archery or gun) and this additionally leaves the meat clean for human consumption."
- "If archery hunts are permitted, I would feel more comfortable with well qualified hunters with proper licenses."
- "I think that if bow hunting were the solution, then the deer need to be processed and donate the meat to the needy."
- "If you are going to have management hunts in San Marcos, it should only be citizens of San Marcos doing the hunts."
- "Sell bow hunting permits and MAKE some money for the city. Donate some of the meat to the Food Bank."
- "We should charge for urban deer hunts to reduce the population and also pay to reduce in areas we are unable to hunt. This should be a cost neutral operation. Thus we must charge for deer hunts."
- "You forced me to make only one choice in questions 18 & 19. I think a combination of trapping, archery hunts & predators, etc. would work best."
- "It will take several combined approaches to reduce deer densities and continued actions to keep them under control."
- "My primary concern with bow-hunting is the difficulty of a quick kill and the increased chances of a wounded deer escaping hunters."
- "How can one consider bow-hunting to be a humane management tool? More chance of wounding the animal. Often the deer is wounded only to suffer a slow painful death."
- "Allowing bow hunting within the city limits would seriously compromise public safety."

- "I do not think bow hunting IN THE CITY is a good idea. It seems dangerous."
- "Bow hunting would be barbaric, already people having deer feeders, which tame deer then shooting them as they feed is barbaric not real hunting."
- "NO BOW HUNTING!"
- "Any hunting within the city limits or community area is dangerous and flat STUPID!"
- "I would not like archery hunts, sharpshooters, natural predator introduction, or euthanasia in my neighborhood."
- "I have fairly often just barely missed hitting deer when they sprang unexpectedly in front of my car. I know that it is only a question of time until it happens. Also, I was not speeding."
- "I have also witnessed many car-deer accidents during this nightly deer invasion."
- "The deer are also a naturally occurring deterrent to people who like to speed through neighborhoods."
- "I have never come close to having a deer collision because I don't drive over the speed limits."
- "Going 30 miles per hour in two separate years, I have been T-Boned by deer causing damage to my car."
- "The deer are extremely destructive and negatively impact my quality of life. They destroy plants and cost to replace landscaping is huge."
- "I think that is a shame that I am prevented from landscaping because of the deer problem. I could spend thousands of dollars and hire a landscaping professional to come in and help me but I refuse to allow the deer to be the reason that forces me to do that. "
- "If people would simply use plants that deer don't eat in their landscaping there wouldn't be nearly as much complaining about the deer. I am way more concerned about things like jobs and transportation issues than any 'wildlife management' issue."
- "I love having the deer around. I ride a bike a lot and have no problems with them. Leave them alone."
- "The deer in San Marcos are a pleasant surprise every time I see them. San Marcos is a wonderful earthy city and I would hate to see less deer any day of the week."
- "Although they sometimes feed on my landscaping, we did move into THEIR territory and I have educated myself on deer-resistant plants... My family enjoys the deer and we think their presence enhances our home."
- "I went for a walk and a buck started approaching me in an aggressive manner."
- "My visiting grandchild was almost hit by a deer who was racing around the corner of our house. It only missed him by a few feet. A very dangerous situation was fortunately avoided."
- "One of our neighbors have been diagnosed with Lyme disease."
- "I don't know if I am qualified to know the most effective technique."
- "I don't know my answer to 13 or 14 because I haven't heard both sides of the issue."
- "I don't feel I'm qualified to say whether there is an overabundance of deer nor proper methods to manage them."
- "Education is often/ always a major key."

"People in San Marcos need to be educated to the fact that feeding the deer is not humane. Deer reproduce based on the amount of available forage. Giving the deer food encourages them to have more young. This is not fair to the deer and it is not fair to the property owners who are tired of the deer tearing up their yards."

"Thanks for doing the survey"

"Thanks for taking steps to manage the local deer."

"If someone opposes the sharpshooter program, they should be required to adopt a deer, pay for its relocation, and buy it a little jacket so it will be warm in the winter. They should also be required to bury it and pay for the damage to my car when I hit it in my neighborhood."

"The 2 people that have started this insane movement had not lived here a year."

"I think that the majority of people are not bothered by the deer... I believe that a few people have stirred up their neighbors about this."

"I can't believe that this has come this far. Boy they were right when they said the squeaky wheel gets the job done. There are so many people that this involves our entire city and people excluding the couple that just moved to this community and started this that don't know about it. "

"a handful of people who do not want to fence their yards."

"Too many deer in Willow Creek Estates because people are feeding the deer."

"EVERYONE I know LOVES the deer. I live in the Willow Creek Estates subdivision, where there are many deer, which is precisely the exact REASON WHY my husband and I purchased our home in Willow Creek and in San Marcos for that matter."

"Willow Creek is first and foremost a single family subdivision and not a wild animal preserve."

"The owner of Amkon feed store remarked one time, when I was purchasing coyote urine to try to discourage the herds of deer, that in San Marcos one resident on a street would come in to buy such products to drive the deer away, and their neighbor down the street would come in to buy deer food! It's a losing battle!"

"Leave the deer alone!"

"Need to do something"

"If we want to feed the deer on our property which we pay the taxes on, no one should infringe upon our right to do so."

" Hopefully, this matter will be addressed rather than talk it to death."

APPENDIX D

IRB EXEMPTION EMAIL

DO NOT REPLY TO THIS MESSAGE. This email message is generated by the IRB online application program.

Based on the information in IRB Exemption Request EXP2009K1700 which you submitted on 04/23/09 10:06:30, your project is exempt from full or expedited review by the Texas State Institutional Review Board.

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Comments:

No comments.

Institutional Review Board
Office of Research Compliance
Texas State University-San Marcos
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WORKS CITED

- Baker, S.V. and J.A. Fritsch. 1997. New territory for deer management: Human conflicts on the suburban frontier. *Wildlife Society Bulletin* 25:404-407.
- Barbour, A. G. and D . Fish. 1993. The biological and social phenomenon of Lyme disease. *Science* 260:1610-1616.
- Beringer, J., L.P. Hansen, J.A. Demand, J.S. Sartwell, and R.M. Mange. 2002. Efficacy of translocation to control urban deer in Missouri: Costs, efficiency, and outcome. *Wildlife Society Bulletin* 30:767-774.
- Bright, A.D. and M.J. Manfredo. 1997. The influence of balanced information on attitudes toward natural resource issues. *Society and Natural Resources* 10:469-483.
- Caughley, G. 1981. Overpopulation. P. A. Jewell and S. Holt, eds. *Problems in management of locally abundant wild mammals*. Academic Press, New York, N.Y.
- Chase, L.C., T.M. Schusler, and D.J. Decker. 2000. Innovations in stakeholder involvement: what's the next step? *Wildlife Society Bulletin* 28:208-217.
- Chase, L.C., W.F. Siemer, and D.J. Decker. 2002. Designing stakeholder involvement strategies to resolve wildlife management controversies. *Wildlife Society Bulletin* 30:937-950.
- Connellly, N.A., D.J. Decker, and S. Wear. 1987. Public tolerance of deer in a suburban environment: implications for management and control. *East Wildlife Damage Control Conference* 3:207-218.
- Conover, M.R., W.C. Pitt, K. Kessler, T.J. DuBow, and W.A. Sandborn. 1995. Review of human injuries, illness and economic losses caused by wildlife in the United States. *Wildlife Society Bulletin* 23:407-414.
- Cornicelli, L., A. Woolf , and L. Rosberry.1993. Residential attitudes and perceptions toward a suburban deer population in southern Illinois. *Transactions Illinois Academy Science* 86:23-32.

- Creacy, Greg. 2006. "Deer Management within Suburban Areas." *Texas Parks and Wildlife Department Publications*.
- Cromwell, J.A., R.J. Warren, and D.W. Henderson. 1999. Live-capture and small-scale relocation of urban deer on Hilton Head Island, South Carolina. *Wildlife Society Bulletin* 27:1025-1031.
- Curtis, P.D. and M.E. Richmond. 1992. Future challenges of suburban white-tailed deer management. *North American Wildlife and Natural Resource Conference* 57:104-114.
- Curtis, P.D. and J.R. Hauber. 1997. Public involvement in deer management decisions: consensus versus consent. *Wildlife Society Bulletin* 25:399-403.
- Decker, D.J. 1987. Management of suburban deer: an emerging controversy. *East Wildlife Damage Control Conference* 3:344-345.
- Decker, D.J. and T.A. Gavin. 1987. Public attitudes toward a suburban deer herd. *Wildlife Society Bulletin* 16:53-75.
- Decker, D.J., T.L. Brown, and G. E Mattfeld. 1987. Integrating social science into wildlife management: barriers and limitations. in Miller, M. L., R. P. Gale, and P.J. Brown, editors. *Social science in natural resource management systems*. Westview, Boulder, Colorado, USA. Pp. 83-92.
- Decker, D.J., T.L. Brown, and G.F. Mattfeld. 1989. The future of human dimensions of wildlife management: can we fulfill the promise? *North American Wildlife and Natural Resource Conference* 54:415-425.
- Decker, D.J., T. L. Brown, N.A. Connelly, J.W. Enck, G.A. Pomerantz, K.G. Purdy, and W.F. Siemer. 1992. Toward a comprehensive paradigm of wildlife management: integrating the human and biological dimensions. In W R. Mangun, editor. *American fish and wildlife policy: the human dimension*. Southern Illinois University, Carbondale, USA. pp. 33-54.
- Decker, D.J., C.C. Krueger, R.A. Baer, JR., B.A. Knuth, and M.E. Richmond. 1996. From clients to stakeholders: a philosophical shift for fish and wildlife management. *Human Dimensions Wildlife* 1:70-82.
- DeNicola, A.J, S.J. Weber, C.A. Bridges, and J.L. Stokes. 1997. Nontraditional techniques for management of overabundant deer populations. *Wildlife Society Bulletin* 25:496-499.
- Doerr, M.L., J.B. McAninch, and E.P. Wiggers. 2001. Comparison of 4 methods to reduce white-tailed deer abundance in an urban community. *Wildlife Society Bulletin* 29:1105-1113.

- Ellingwood, M. and J.V. Signesi. 1986. Management of an urban deer herd and the concept of cultural carrying capacity. *Northeastern Deer Technology Community* 22:42-45.
- Guynn, D.E. and M.K. Landry. 1997. A case study of citizen participation as a success model for innovative solutions for natural resource problems. *Wildlife Society Bulletin* 25:392-398.
- Hansen, L. and J. Beringer. 1997. Managed hunts to control white-tailed deer populations on urban public areas in Missouri. *Wildlife Society Bulletin* 25:484-487.
- Henderson, D.W., R.J. Warren, D.H. Newman, J.M. Bowker, J.S. Cromwell, and J.J. Jackson. 2000. Human perceptions before and after a 50% reduction in an urban deer herd's density. *Wildlife Society Bulletin* 28:911-918.
- Henderson, D.W., R.J. Warren, J.A. Cromwell, and R.J. Hamilton. 2000. Responses of urban deer to a 50% reduction in local herd density. *Wildlife Society Bulletin*. 28:902-910.
- Insurance Journal. 2006. Wildlife making Texas highways hazardous. *Insurance Journal*. Wells Publishing Inc. Oct. 17, 2006. Accessed online at <http://www.insurancejournal.com/news/southcentral/2006/10/17/73354.htm>
- Ishmael, W.E. and O.J. Rongstad. 1984. Economics of an urban deer-removal program. *Wildlife Society Bulletin* 12:394-398.
- Kilpatrick, H.J. and W.D. Walter. 1997. Urban deer management: A community vote. *Wildlife Society Bulletin* 25:388-391.
- Kilpatrick, H.J. and J.W. Turner. 1997. Urban deer contraception: The seven stages of grief. *Wildlife Society Bulletin* 25:515-519.
- Kilpatrick, H.J., and W.D. Walter. 1999. A controlled archery deer hunt in a residential community: Cost, effectiveness, and deer recovery rates. *Wildlife Society Bulletin* 27:115-123.
- Kilpatrick, H.J. and S.M. Spohr. 2000. Spatial and temporal use of a suburban landscape by female white-tailed deer. *Wildlife Society Bulletin* 28:1023-1029.
- Kilpatrick, H.J. and A.M. LaBonte. 2003. Deer hunting in a residential community: The community's perspective. *Wildlife Society Bulletin* 31:340-348.

- Kilpatrick, H.J., A.M. LaBonte, J.S. Barclay, and G. Warner. 2004. Assessing strategies to improve bowhunting as an urban deer management tool. *Wildlife Society Bulletin* 32:1177-1184.
- Kilpatrick, H.J. A.M. LaBonte, and J.S. Barclay. 2007. Factors affecting bowhunter access in suburban areas. *Wildlife Society Bulletin* 71:2102-2105.
- Kuser, J.E. and L.J. Wolgast. 1983. Deer road kill increases with no-firearms discharge law. *Bulletin New Jersey Academy of Science* 2:71-72.
- Lauber, T.B. and B.A. Knuth. 2000. Suburban residents' criteria for evaluating contraception and other deer management techniques. *Human Dimensions of Wildlife* 5:1-17.
- Lauber, T.B. and B.A. Knuth. 2004. Effects of information on attitudes toward suburban deer management. *Wildlife Society Bulletin* 32:322-331.
- Loker, C.A. 1996. Human dimensions of suburban wildlife management: insights from three areas of New York State. *M.S. Thesis, Cornell University, Ithaca, N.Y.*
- Lund, R.C. 1997. A cooperative, community-based approach for the management of suburban deer populations. *Wildlife Society Bulletin* 25:488-490.
- Meine, C. 1988. Aldo Leopold: his life and work. University of Wisconsin, Madison, USA.
- Meshea, W.J. and J.H. Rappole. 1997. The science and politics of managing deer within a protected area. *Wildlife Society Bulletin* 25:443-446.
- Messmer, T.A., S.M. George, and L. Cornicelli. 1997. Legal considerations regarding lethal and nonlethal approaches to managing urban deer. *Wildlife Society Bulletin* 25:424-429.
- Messmer, T.A., L. Cornicelli, D.J. Decker, and D.G. Hewitt. 1997. Stakeholder acceptance of urban deer management techniques. *Wildlife Society Bulletin* 25:360-366.
- McAaninch, J.B., editor. 1995. Urban deer: a manageable resource? Proc. symposium 55th Midwest Fish and Wildlife Conference, 12-14 December 1993, St. Louis, Mo. North Cent. Sect., *The Wildlife Society*.
- McComas, K.A. and W. Scherer. 1999. Providing balanced risk information in surveys used as citizen participation mechanisms. *Society and Natural Resources* 12:107-119.

- Nielsen, C.K., R.G. Anderson, M.D. Grund. 2003. Landscape influences on deer-vehicle accident areas in an urban environment. *Journal of Wildlife Management* 67:46-51.
- National Safety Council. 2009. Injury Facts Sheet.
<https://www2.nsc.org/library/facts.htm>
- Purdy, K.G., and D.J. Decker. 1989. Applying wildlife values information in management: the wildlife attitudes and values scale. *Wildlife Society Bulletin* 17:494-500.
- Raik, D.B, D.J Decker, and W.F. Siemer. 2006. Capacity Building: A new focus for collaborative approaches to community-based suburban deer management? *Wildlife Society Bulletin* 34:525-530.
- Riley, S.J., D.J. Decker, J.F. Organ, W.F. Siemer, G.F. Mattfeld, and G. Parsons. 2002. The Essence of Wildlife Management. *Wildlife Society Bulletin* 30:585-593.
- Romin, L.A., and J.A. Bissonette. 1996. Deer-vehicle collisions: status of state monitoring activities and mitigation efforts. *Wildlife Society Bulletin* 24:276-283.
- Rondeau, D. 2001. Along the Way Back from the Brink. *Journal of Environmental and Economic Management* 42(2001):156-82.
- Rondeau, D. and J.M. Conrad. 2003. Managing Urban Deer. *American Journal of Agriculture and Economics* 85:266-281.
- Rutberg, A.T. 1997. Lessons from the urban deer battlefield: a plea for tolerance. *Wildlife Society Bulletin* 25:520-523.
- Schmitz, O. and A. R. E. Sinclair. 1997. Rethinking the role of deer in forest ecosystem dynamics. Pages 201-223 in W. J. McShea, H. B. Underwood, and J. H. Rappole, eds. *The science of over-abundance: deer ecology and population management*. Smithsonian Institution Press, Washington, D. C.
- Schusler, T.M. 1999. Co-management of fish and wildlife in North America: a review of literature. Department of Natural Resources, *Human Dimensions Research Unit Publication* 99-2, Cornell University, Ithaca, New York, USA.
- Siemer, W.F., B.A. Knuth, D.J. Decker, and V.L. Alden. 1992. Human perceptions and behaviors associated with Lyme disease: implications for land and wildlife management. HDRU Ser. 92- 8, *Human Dimensions Research Unit Publication*., New York State Coll. Agric. and Life Sci., Cornell Univ., Ithaca, N.Y.

- Sinclair, A.E. 1997. Carrying capacity and the overabundance of deer: a framework for management. The science of overabundance: deer ecology and population management. *Smithsonian Institution Press*, Washington, D.C. pp. 380-394.
- Stout, R.J., D.J. Decker, and B.A. Knuth. 1994. Public involvement in deer management decision-making: comparison of three approaches for setting deer population objectives. *Human Dimensions Research Unit Publication* 94-2. Dep. Natural Resources, Cornell Univ., Ithaca, N.Y.
- Stout, R.J., D.J. Becker, B.A. Knuth, J.C. Proud, and D.H. Nelson. 1996. Comparison of three public-involvement approaches for stakeholder input into deer management decisions: a case study. *Wildlife Society Bulletin* 24:312-317.
- Stout, R.J., B.A. Knuth, and P.D. Curtis. 1997. Preferences of suburban landowners for deer management techniques: a step toward better communication. *Human Dimensions Research Unit Publication* 1.25-2. Department of Natural Resources, Cornell University, Ithaca, N.Y.
- Stratemann, Bert. 20 April 2009. Director of Animal Control, City of San Marcos, Texas. Personal Interview.
- Stromayer, K.A.K. and R.J. Warren. 1997. Are overabundant deer herds in the eastern United States creating alternate stable states in forest plant communities? *Wildlife Society Bulletin* 25:227-234.
- Sullivan, T.L. and T.A. Messmer. 2003. Perceptions of deer-vehicle collision management by state wildlife agency and department of transportation administrators. *Wildlife Society Bulletin* 31:163-173.
- Susskind, L. and J. Cruikshank. 1987. *Breaking the impasse: consensual approaches to resolving public disputes*. Basic Books, Inc., New York, N.Y.
- Swihart, R.K. and A.J. DeNicola. 1997. Public involvement, science, management, and the overabundance of deer: Can we avoid a hostage crisis? *Wildlife Society Bulletin* 25:382-387.
- Tilghman, N.G. 1989. Impacts of white-tailed deer on forest regeneration in northwestern Pennsylvania. *Journal of Wildlife Management* 53: 524-532.
- United States Fish and Wildlife Service. 2006. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. http://library.fws.gov/pubs/nat_survey2006_final.pdf.
- Walters, C. 1986. *Adaptive management of renewable resources*. McMillan Publishing, New York, N.Y. Pp 374.

- Warren, R.J., L.M. White, and W.R. Lance. 1995. Management of urban deer populations with contraceptives: practicality and agency concerns. Pages 164-170 In J. B. McAninch, ed. *Urban deer: a manageable resource?* Proc. symposium 55th Midwest Fish and Wildlife Conference, 12-14 December 1993, St. Louis, The Wildlife Society.
- West, B.C. and J.A. Parkhurst. 2002. Interactions between deer damage, deer density, and stakeholder attitudes in Virginia. *Wildlife Society Bulletin* 30: 139-147.
- Winter, M. "Deer Ahead!" *ALS NEWS*, Cornell University, College of Agriculture and Life Sciences, December 1999, p. 1.
- Whitaker, D.M., M.J. Manfredo, P.J. Fix, R.Sinnott, S. Miller, and D.J. Vaske. 2001. Understanding beliefs and attitudes about an urban wildlife hunt near Anchorage, Alaska. *Wildlife Society Bulletin* 29:1114-1124.
- Wright, B.A., R.A. Kaiser, and J.E. Fletcher. 1988. Hunter access decisions by rural landowners: an east Texas example. *Wildlife Society Bulletin* 16:152-158.

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Matt attended Lone Star Community College in Houston for two years before going to Texas State in San Marcos. There he received a Bachelor of Science in Geography with a focus on Geographical Information Science. His course work focused on physical geography and environmental resources and he minored in geology. During graduate school, Matt was employed by the department of geography at Texas State. He instructed physical geology labs for Dr. Rene DeHon.

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