THE VIABILITY OF CONSERVATION SUBDIVISIONS AS HABITAT FOR URBAN CARNIVORES IN NORTH CENTRAL TEXAS SUBURBS

by

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Abstract

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The University of Texas at Arlington, 2017

Supervising Professor: David Hopman

The purpose of this research is to examine perceptions of conservation subdivisions as habitat for urban carnivores in North Central Texas suburbs. This research was conducted through the University of Texas at Arlington; Landscape Architecture Program. The literature review examines the history of conservation subdivisions and their use within North Central Texas as well as their application as an ecological solution to present-day threats to biodiversity with a focus on mammalian apex carnivores. It further explores their use as habitat in the context of urban patches and corridors. Additionally, the practice of bioregionalism was reviewed in contrast to current political boundaries governing North Central Texas cities as related to conservation subdivisions. This study targets conservation subdivisions located within the North Central Texas Councils of Government (NCTCOG), the Dallas-Fort Worth (DFW) metropolitan statistical area of North Texas. The subdivision ecoregions represented include Cross Timbers and Blackland Prairies.

The study employs qualitative research methods to gain insight into participant perceptions. Phone interviews were compiled from 14 Interview subjects chosen for their professional work related to or knowledge of conservation subdivisions or urban ecology in the study area. All respondents consented to be named and are considered experts in their field. Findings were attained through a process of rigorous coding methods and domain analysis.

As the profession of landscape architecture increases its reach and influence in our natural and built world, it is important to gain awareness of urban development in various contexts. In the context of conservation subdivisions in North Central Texas suburbs, this research furthers public and professional

knowledge concerning urban wildlife habitat for urban carnivores and its implications towards conservation efforts overall.

These data support the view that conservation subdivisions are, in part, a viable solution as a conservation tool and are perceived as viable habitat for urban carnivores in the study area. However, further community education and research are needed to expand the effective use of conservation subdivisions in North Texas. The development of conservation subdivisions in the study area is perceived as a developer marketing tool to increase profits and fall short of intended conservation goals lacking actionable long-term maintenance plans. Recommendations based on the findings and for future research are presented to improve the future sustainability of urban wildlife habitat and therefore increase wildlife diversity and open space conservation within high-density, metropolitan areas.

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Chapter 1: Introduction

1.1 Background

The 21st century is one of the most environmentally conscious eras of all humankind. As scientific information becomes more readily available and openly discussed, the issues become easier to understand at the individual level. Communities begin to understand and accept the implications of widespread practices affecting the places in which they reside. Greater awareness and understanding changes the relationship between humans and nature which leads to landscape and nature conservation becoming more important in public and political discussions (Schenk, Hunziker, & Kienast, 2007). According to the 2014, Texas Statewide Voter Opinion Survey on issues related to Texas land, parks, natural habitat and other natural areas, 84% of respondents acknowledge the need for protecting natural areas ("Texas_Parks_survey_12-14_handout.pdf," n.d.). A Texas Parks and Wildlife Department media release quotes research findings on the issue:

> "Texans' sentiment on these issues has remained remarkably stable over the past decade, suggesting that these opinions are more than transient views—they are closer to bedrock beliefs and values that persist for a generation or more…Voters continue to be very aware of the need for conservation efforts and parkland in our growing state" ("Study Shows Strong Support for Texas State Parks," n.d.).

However, acting on those sentiments prove challenging. TPWD presents the top conservation challenges in Texas as **"**habitat loss and fragmentation, limited water for environmental flows, invasive species and climate change" ("Conservation Challenges — Texas Parks & Wildlife Department," n.d.). Research has demonstrated that there are many reasons for habitat conservation which include:

- Protecting biodiversity,
- Securing wildlife food supplies,
- Securing land availability to use in future research,
- Providing quality of life,
- Providing eco-tourism,
- Preserving wildlife as environmental indicators,
- Providing educational benefits to communities, and
- Providing psychological benefits
  (Dearborn & Kark, 2010; "Economic Benefits of Land Conservation: ConservationTools," n.d.; Pearce, 1994; *The Biophilia Hypothesis*, n.d.; Tisdell, 2004).

The 2017 Conservation in the West Poll by Colorado College surveyed seven western states and found that 80% of the voters deemed low water levels in rivers a serious issue, 76% said pollution of

waterways is a serious issue, and 71% said poorly planned growth and development is a serious issue ("Western voters prioritize conservation and keeping public lands public, cpoll finds," 2017).

A general internet search today yields an array of the most pressing environmental issues humanity faces today. Environmental issues affect biodiversity, and though subjective, there is an overall consensus. Scientists have categorized these environmental stressors using the acronym, HIPPO (see operational definition):

H-Habitat loss and fragmentation
I-Invasive species
P-Pollution
P-Human population, and
O-Overharvesting (Wilson, 2016).

Landscape architecture has evolved to be a discipline with the potential to bring different professions together. Per the American Society of Landscape Architects (ASLA), landscape architects are stewards of the land. The profession works to maximize land use, add value to a project and minimize costs, all with minimum disruption to nature ("ASLA: Glossary," n.d.) Stewardship at the broadest sense, is the "recognition of our collective responsibility to retain the quality and abundance of our land, air, water and biodiversity, and to manage this natural capital in a way that conserves all of its values, be they environmental, economic, social or cultural" ("Stewardship | Land Stewardship Centre of Canada," n.d.). Acting as stewards of the land, landscape architecture integrates natural and built elements, taking into consideration the cultural and scientific knowledge available and paying close attention to resource conservation to the end that the resulting environment serves a useful and enjoyable purpose. H.I.P.P.O. recounts several of the largest threats to biodiversity and conservation issues. This study explores these issues in terms of what landscape architects and related professions may contribute regarding urban ecological habitat design in response to the greater need for sustainable systems.

Landscape architects (LA) can address declines in biodiversity by addressing specific HIPPO and climate change issues in their planning and design practices. Reports regarding the affects from current development practices are on the rise. For instance, according to the National Wildlife Federation:

> "Sprawling development poses one of the most serious threats to America's wildlife heritage. Left unmanaged, sprawl could consume significant portions of the remaining green space in the country's fastest growing large metro areas and counties, which are home to nearly one-third of imperiled species in the U.S. Despite the threat, most local governments have failed to protect their open space from sprawling development" (nwf.org, 2017).

A joint venture by Smart Growth America, the National Wildlife Fund (NWF), and NatureServe, "Endangered by Sprawl," reports that by 2025, the demand for open space will outstrip supply by approximately 133% in the DFW metropolitan area. Sprawl and high-density development increase the likelihood of wildlife and biodiversity decline (Ewing, Kostyack, Chen, Stein, & Ernst, 2005). The expanding footprint of development and increasing fragmentation puts added stress on diminishing wildlife resources and their habitats. Sprawl is one of the most obvious pressures to decline in wildlife diversity. According to the United States Department of Agriculture (USDA), urban landscapes present additional wildlife and habitat conservation concerns that arise from the addition of impervious rooftops, roads, parking lots, and compacted areas that increase surface runoff, delivering sediment, nutrients, hydrocarbons and other pollutants to receiving bodies of water. In addition, these landscapes also experience greater populations of invasive species and weeds that increase the potential of damaging wildfire. ("Urban Conservation | NRCS Plant Materials Program," n.d.).

Developers have begun to respond and provide greener alternatives ranging from landscaping for climate change to neighborhoods designed for sustaining tree farms (Builder Magazine |,Weber, 2016, Goodman, 2016). Conservation development is another area gaining increased attention.

Conservation development (CD, see operational definition) is an approach to the design, construction, and stewardship of the land that achieves functional protection of natural resources, while at the same time providing social and economic benefits to human communities through development ("What is Conservation Development? | Conservation Development," n.d.). CD is a method of protecting green infrastructure features which are intended to reduce adverse impacts of development (Milder, 2007). In many states, local governments must have a green infrastructure plan. However, in Texas, open space planning is purely voluntary (Ewing et al., 2005). CD encompasses a broad range of project types including conservation subdivisions, a cluster typology of CD (Milder, 2007). Benefits of conservation subdivisions development include:

- Lessened effect of development on greenhouse gasses (especially in exurban areas),
- Reduced development impacts on landscapes,
- Decreased infrastructure costs,
- Increased marketability,
- Increased resident benefits (recreation, sense of community, quality of life),
- Reduced tax dollars spent in open space acquisition, and
- Improved regeneration of ecosystem services (Carter, 2009).

The present study is primarily concerned with conservation subdivisions in North Texas suburbs as a means to provide ecosystem services (habitat) for wildlife with a focus on urban carnivores. Conservation subdivision planning may focus on the regeneration of ecosystem services such as the restoration of grasslands for carbon sequestration and wildlife. The main challenges to the development of conservation subdivisions include lack of regulatory codes, affordability, and developer risk aversion due to the reluctance to accept new development ideas (Carter, 2009). Conservation subdivisions within North Texas are few as compared to other states where green infrastructure plans are required as a component of county and comprehensive municipal plans.

Exploring perceptions of conservation subdivision development in urban metropolitan areas can provide insight into the ease with which communities accept, adapt, and implement habitat and open space conservation at the site, city, and regional design scales in North Texas. Chapter 2's literature review outlines discourse and debate concerning the history, trends, themes, and current implementation of conservation subdivisions in North Central Texas and the United States. It further examines the current situation regarding urban carnivores and how existing policy affects their existence. In North Central Texas.

1.2 Purpose of the Study

The primary objective of this research is to study the viability of conservation subdivisions as wildlife habitat for urban carnivores. The target audience is landscape architects and related design professionals. The data explores conservation subdivisions as a potential development strategy to protect or conserve quality wildlife habitat, specifically habitat geared towards urban carnivores.

At the onset of this study, conservation subdivisions were found in only two of the 169 cities within the NCTCOG study area. Providing information related to the existing developments and projects can assist professionals to incorporate or adapt their planning, design, and marketing strategies in response to environmental and community needs and desires. Conservation subdivisions are a potential solution to many of the environmental pressures policy, design, and planning professionals face today.

1.3 Research Questions

This study employs qualitative research methods as described by Sommer & Sommer (2001). The researcher interviewed participants to gain an understanding of their perceptions regarding conservation subdivisions and their role in development as it affects wildlife habitat, specifically for urban carnivores. Data were analyzed through coding and domain analysis as described by Saldana (2015) and (Atkinson & Haj, (1996). Structured coding analysis was used such that categories were categorized within other categories through three cycles of coding methods. Then domain analysis was performed to understand the how the taxonomy or categorization was related. Grounded theory described by Strauss & Corbin (1998) was then applied to the data to arrive at emerging themes. The research questions for this study were:

A. Primary

1. From an ecological standpoint: To what extent can conservation subdivisions provide a viable approach to creating patch habitat for urban carnivores?
2. From a public standpoint: To what extent should conservation subdivisions provide design features as patch habitat for urban carnivores?

B. Secondary

1. How do North Central Texas conservation subdivisions affect urban wildlife habitat conservation?
2. What are the barriers to implementation of conservation subdivision development in North Central Texas?
3. What can be done to encourage more conservation subdivisions development in North Texas?
4. What are the implications of this study's results for the practice of landscape architecture in North Cental Texas?

1.4 Operational Definitions of Key Terms

Biodiversity. The total variation in organisms, in past times and present, in locations up to and including the entire planet, and organized at three levels: ecosystems, species comprising the ecosystems, and genes prescribing the traits of the species (Wilson, 2016, p.227).

Blackland prairie. Arguably the most critically threatened ecoregion in Texas. It stretches 300 miles from the Oklahoma border to near San Antonio (Figure 1). It lies along one of the most development-intensive areas in Texas, along the IH-35 corridor. It is known for easily-eroded Cretaceous shales and marls that produce expansive, mineral rich black clay soils. The land is predominantly grasslands that are gently rolling to mostly flat and easily cleared with few barriers to

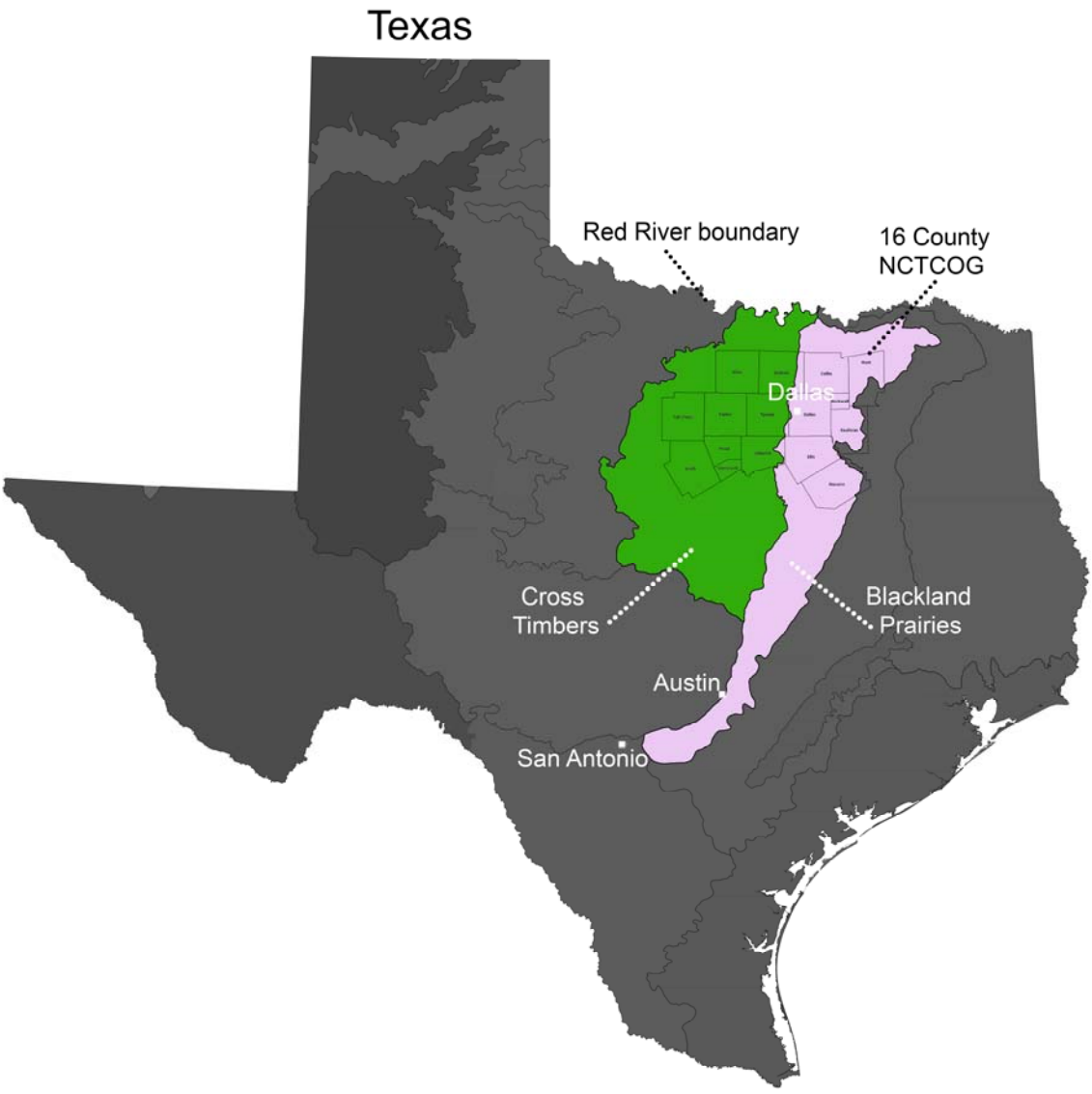


Figure 1. EPA Level III Ecoregions Cross Timbers and Blackland Prairies
Adapted from TPWD, NCTCOG.

development (*Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin*, n.d., "TPWD: Texas Conservation Action Plan (TCAP)," n.d.).

Cross Timbers and Prairies (referred to herein as Cross Timber). A woodland and savanna ecoregion noted historically as a "marker" of sorts for progress along the east-west Blackland Prairies and the Plains. The woodlands were historically dominated by old Post Oak and Blackjack Oak canopy on coarse sandy erosion-resistant rock soils. The oaks were usually not favored by settlers and cleared for

farmland (*Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin*, n.d., "TPWD: Texas Conservation Action Plan (TCAP)," n.d., Figure 1).

Climate change. A change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. Climate change weather patterns include pervasive and significant shifts in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer (Karl & Trenberth, 2003, US EPA, n.d.).

Cluster development, also known as open-space development. The grouping of a particular development's residential structures on a portion of smaller lots clustered together. Clustering preserves a percentage of the site as protected open space (Whyte 1964; Corser 1994, Figure 2).

Conservation development (CD). Projects that combine land development, land conservation, and revenue generation while providing functional protection for conservation resources. (Milder, 2007.Figure 2).

Conservation easement. A contract between a landowner, a fee holder (usually a builder in the case of conservation subdivisions), and an easement holder where a restriction is placed on a piece of property to protect its associated resources. ("Introduction to Conservation Easements," n.d., Merenlender, Huntsinger, Guthey, & Fairfax, 2004).

Conservation subdivision (CS). Residential developments where half or more of the buildable land area is designated as undivided, permanent open space, where the primary objective of the conservation design is to protect natural areas within the residential development (Arendt & Brabec, 1994; Arendt & Harper, 1996; "Clarifying the Conservation Subdivision Design Approach," n.d, Figure 2).

Ecological drought. A prolonged and widespread deficit in naturally available water supplies, including changes in natural and managed hydrology, that create multiple stresses across ecosystems ("Ecological Drought | National Climate Change and Wildlife Science Center," n.d.).

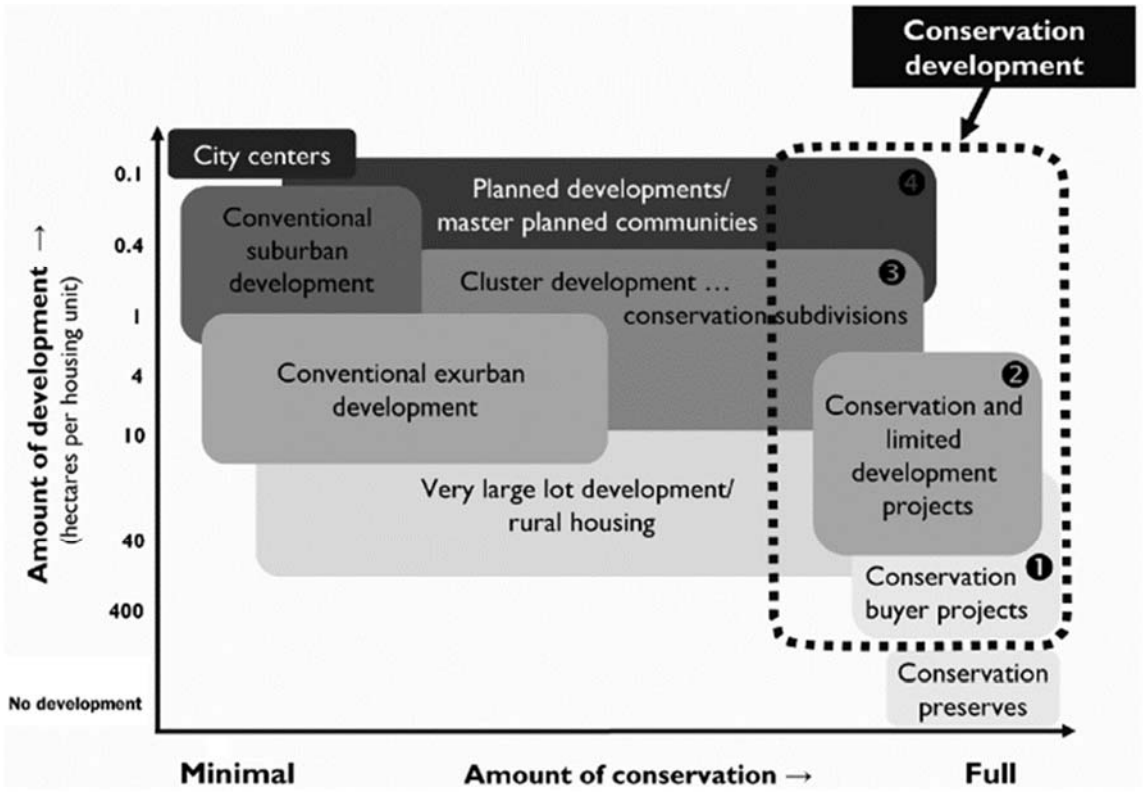


Figure 2. Conservation Development: Land-use patterns
(Milder, 2007).

Ecosystem (ecoregion). A locality with particular physical traits and the distinctive species that live within it such as a forest patch (Wilson, 2016, p.227). For this study, an ecosystem is defined to be one delimited by the EPA's level III ecoregion definition. Level III is the hierarchical level within the North American continent divided into 182 smaller ecoregions (US EPA, n.d.). North Texas conservation subdivisions studied are located within the Blackland Prairie and Cross Timbers ecoregions (Figure 1).

Fragmentation. A spatial process in land transformation that consists of the breaking up of a habitat, ecosystem, or land-use type into smaller parcels (Didham, 2010; Forman, 1995).

HIPPO. An acronym often used by conservation scientists to summarize the most ruinous activities caused by man. In order of importance, they are: H-habitat loss and fragmentation, I-Invasive Species, P-Over Population, P-Pollution, and O-Overhunting (Wilson, 2016).

Landscape ecology principles in landscape architecture and land use planning. The science of studying and improving relationships between ecological processes in the built environment. Fundamental processes are considered through small and large land patches, edges, boundaries,

corridors and stepping stones for species movement which make up fine or coarse land mosaic networks (Dramstad, Olson, & Forman, 1996; Forman, 1995).

North Central Texas Councils of Government (NCTCOG). A voluntary association of, by and for local governments, established to assist local governments in planning for common needs, cooperating for mutual benefit, and coordinating for sound regional development. It serves a 16-county region of North Central Texas which surrounds the urban centers of Dallas and Fort Worth (Figure 3, "Welcome to NCTCOG.org," n.d.).

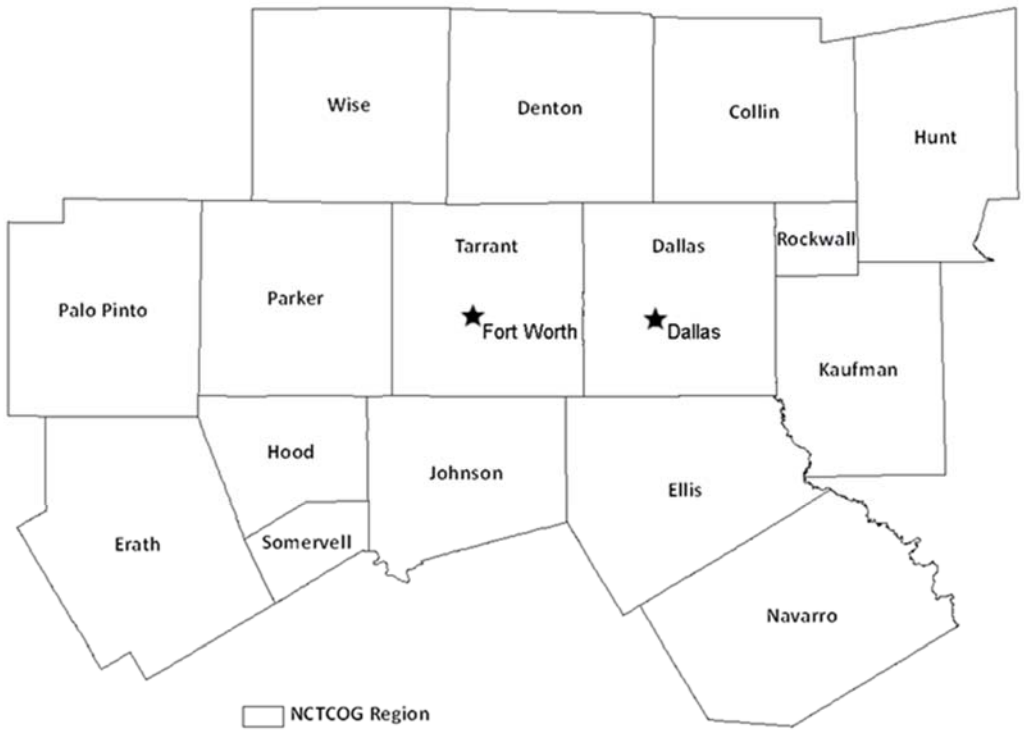


Figure 3. Sixteen counties of NCTCOG, adapted

Sprawl. A pattern of low-density, often unsightly, automobile-dependent development that has been a common form of growth outside of urban areas since at least World War II ("Defining Sprawl and Smart Growth | Community and Regional Development Institute," n.d.).

The Sustainable Sites Initiative (SITES). An interdisciplinary effort to create voluntary national guidelines and performance benchmarks for sustainable land design, construction, and maintenance practices. Landscapes are considered sustainable if they reduce water demand, filter and reduce

stormwater runoff, *provide wildlife habitat*, reduce energy consumption, improve air quality, improve human health, and increase outdoor recreation opportunities ("Home | SITES," n.d.; Washington, n.d).

Triangulation. Examining the consistency of different data sources from within the same or different methods in an investigation to produce deeper understanding (Denzin, 1978; Patton, 1999).

Urban carnivores. For the purpose of this study, an urban carnivore refers to the most common top land mammalian found in North Central Texas prairies and cross timbers: bobcats and coyotes. These carnivores are considered apex or near apex predators found at or near the top of the food web.

Vision North Texas (VNT). A vision statement plan for the NCTCOG 16-county area and a set of twelve guiding principles for the region's growth and development. Partnership is encouraged although voluntary ("Vision North Texas," n.d.).

1.5 Research Methods

This study used qualitative research methods including data source triangulation (Denzin, 1978; Patton, 1999). First, the existing literature on conservation subdivisions and chosen projects within the North Texas Cross Timbers and Blackland Prairie ecoregions was examined. Second, researcher field data and perceptions were recorded for three projects within the study area. Finally, phone interviews (Brinkmann, 2014; Sommer, 2001) were conducted with professionals related to the design, development, and maintenance of the conservation subdivisions in North Central Texas. Urban biologists were also included. Respondents were chosen for their field experience or residence in one of the study conservation subdivisions. The findings collected from the field data, and interview respondents were analyzed using coding and domain analysis described by Saldana (2015) and Atkinson & Haj (1996) to arrive at a grounded theory (Strauss & Corbin, 1998). Dedoose.com, subscription software, was used to organize and code the interviews. Cmap online concept map software was used to examine the concepts. The results provide insight regarding the professional perceptions of conservation subdivisions as they relate to wildlife habitat within the study area.

1.6 Significance and Limitations

The significance of this study is its intended potential to provide landscape architects and related professionals (particularly those concerned with environmental design and planning) information

regarding the needs of wildlife within urban settings and how conservation development may mitigate conflicts. As stewards of the environment, LAs and design professionals are in a unique position to apply knowledge of nature to create high-performance landscapes in which design and ecological goals can coexist (Beck, 2013; Contributor, 2013). Increased knowledge will allow design professionals to adjust and adapt design strategies and proposals to meet client's needs and desires as they relate to the environmental pressures their projects place on wildlife and hence, on wildlife diversity in metropolitan areas. Furthermore, this study contributes to 'diffusion of innovation'; the rate at which new ideas spread over time (Rogers, 2003). Gaining insight and reporting perceptions concerning conservation subdivisions and wildlife in North Central Texas will enable more meaningful discussions among concerned professionals.

The limitations of this study include lack of available data on area subdivisions and the number of conservation subdivisions in the study area. North Texas development consist of few conservation subdivisions which limits the local professional involvement within the study area as interview subjects. Interviews and research were obtained within a one-semester time-period which limited the number of interviews conducted. Published research in the discipline of conservation subdivisions and wildlife are limited with research specific to North Central Texas especially lacking. Furthermore, while studies on urban carnivores and suburban habitat have increased in recent times, they are still limited.

1.7 Research Outline

Chapter 1 introduces the thesis topic, The Viability of Conservation Subdivisions as Habitat for Urban Carnivores in North Central Texas Suburbs. Chapter 2 presents a review of literature about the environmental pressures faced within the confines of an urban environment situated within the Blackland Prairie and Cross Timbers ecoregions. It also reviews conservation subdivisions as a solution to environmental pressures and their uses as an ecological service for urban wildlife habitat. Additionally, the available literature about the benefits and barriers to conservation subdivision implementation is covered. Chapter 3 presents the research methods used in the study. Chapter 4 presents the findings and analysis focusing on the major themes revealed through domain analysis. Finally, the conclusion in Chapter 5 discusses the findings, thoughts on the literature, importance, and implications for the profession of landscape architecture, and future research needed on the topic to further the discussion

and education in the area of conservation subdivisions in general and specifically to ecological processes related to urban wildlife habitat that can be addressed by landscape architects.

Chapter 2: Literature Review

2.1 Introduction

A literature review provides the background for research by studying the need, history, current theories and debate on the issues at hand (Sommer & Sommer, (2001). In this instance, conservation subdivisions and their implementation as related to wildlife. For the present study, the underlying causes for biodiversity decline and environmental pressures in the Blackland Prairies and Cross Timbers ecoregions are examined as a central focus to the question of how conservation subdivisions serve to provide ecological services for urban wildlife habitat in North Central Texas. Texas is a state owned primarily by individual private land owners in which land development adheres to a market-driven approach. Conservation development is often determined by regional policy in other regions in the United States. The DFW regional area lacks an over-arching conservation policy. Bioregional policies are explored as an alternative. To provide a basis for qualitative research, conservation subdivisions and their place within North Central Texas ecoregions were examined. The review concludes with an examination of the existing literature on urban carnivore ecology, conflict, and conservation to place emphasis on conservation subdivision habitat issues. Urban carnivores were chosen for their place at the top of their food web and due to their increasing visibility as urban wildlife within DFW area suburbia.

2.2 The Case for Landscape Architecture Focus on Conservation

This research adopts the main ecological principles concerning cities presented by Picket, & Cadenasso, (2008). They describe cities as ecosystems, spatially heterogeneous, and dynamic. In cities, human and natural processes interact and ecological processes are still at work and are important. Landscape architects are in a position to directly affect the potential impact their projects have on the environment. Within this framework of urban ecology, specific HIPPO threats that LAs may potentially affect are examined. HIPPO and climate change are reported to be the leading causes of loss of biodiversity. Kolbert, (2014) explains that humanity is in the midst of the sixth mass extinction and summarizes a group of paleontologists as they explain the phenomenon as an event that eliminates a “significant proportion of the world’s biota in a geologically insignificant amount of time” (Anthony Hallam

and Paul Wignall) or as “substantial biodiversity losses” that occur rapidly and are “global in extent” (David Jablonski).

2.2.1 Extinction rates. In the book, *Half-Earth; Our Planet’s Fight for Life*, biologist, E.O. Wilson states that extinction is accelerating at rates far more rapidly than originally thought. A 2015 international team of researchers present data that suggest extinction rates as a result of human activity are in the vicinity of 100 to 1000 times higher than before the spread of humanity (Ceballos et al., 2015; Wilson, 2016). That means the number of species that went extinct in the past 100 years would have taken 11,400 years to go extinct under natural extinction rates. For example, “without human activities, the planet should lose a bird species only about once every 1,000 years”. The rapid loss of species we see today is estimated by experts to be between 1,000 and 10,000 times higher than the natural background extinction rate (Figure 4).

Gerardo Ceballos (2015), lead author of the study is quoted as saying “If it is allowed to continue, life will take many millions of years to recover, and our species itself would likely disappear early on.” Sandford researcher, Ehrlich, states, “The study shows without any significant doubt that we are now entering the sixth great mass extinction event,” and goes on to describe the situation such that “There are examples of species all over the world that are essentially the walking dead,” (University, 2015).

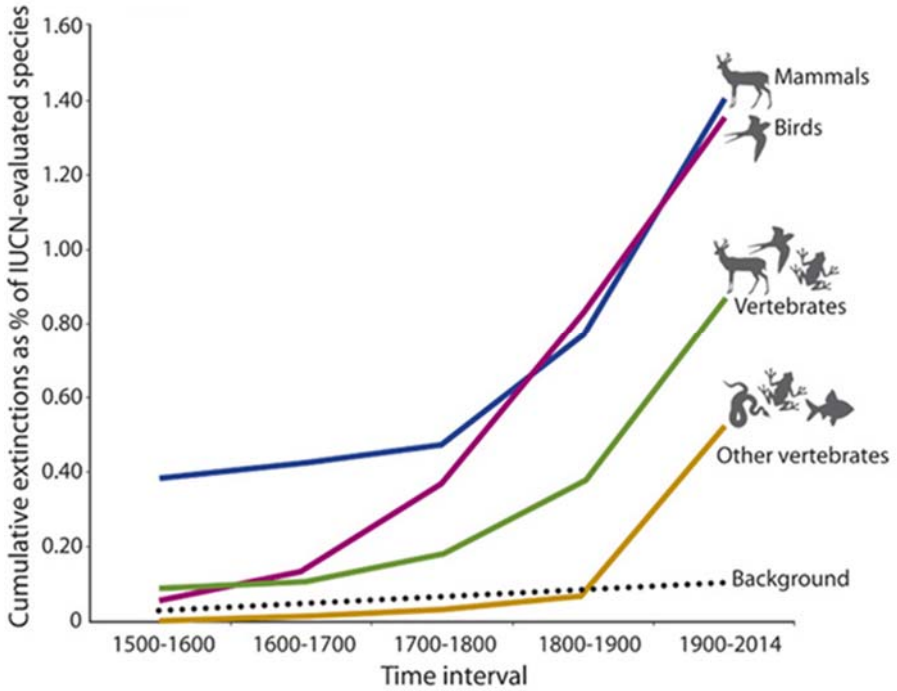


Figure 4. Cumulative extinction rates as % of evaluated species (IUCN, 2012).

2.2.2 Local conservation priority: Blackland Prairie and Cross Timbers. Within the Blackland Prairie of Texas, less than one percent of the original vegetation remains in scattered parcels across the region ("Remnant Grasslands of the Fayette Prairie, Texas on JSTOR," n.d.). Almost all of the remaining Blackland Prairie is under private ownership. About 12% of remnant Blackland Prairie is currently under protection held by The Nature Conservancy of Texas (TNCT, Figure 5). Nearly 60% is voluntarily protected and under private land registry programs administered by TNCT. The status of the Blackland Prairie ecoregion is categorized as critical/endangered. It has overall been diminished to a mere 5,000 highly fragmented acres, making it one of the most imperiled ecosystems in North America ("Clymer Meadow Preserve | The Nature Conservancy," n.d., "Texas Blackland Prairies | Ecoregions | WWF," n.d.).

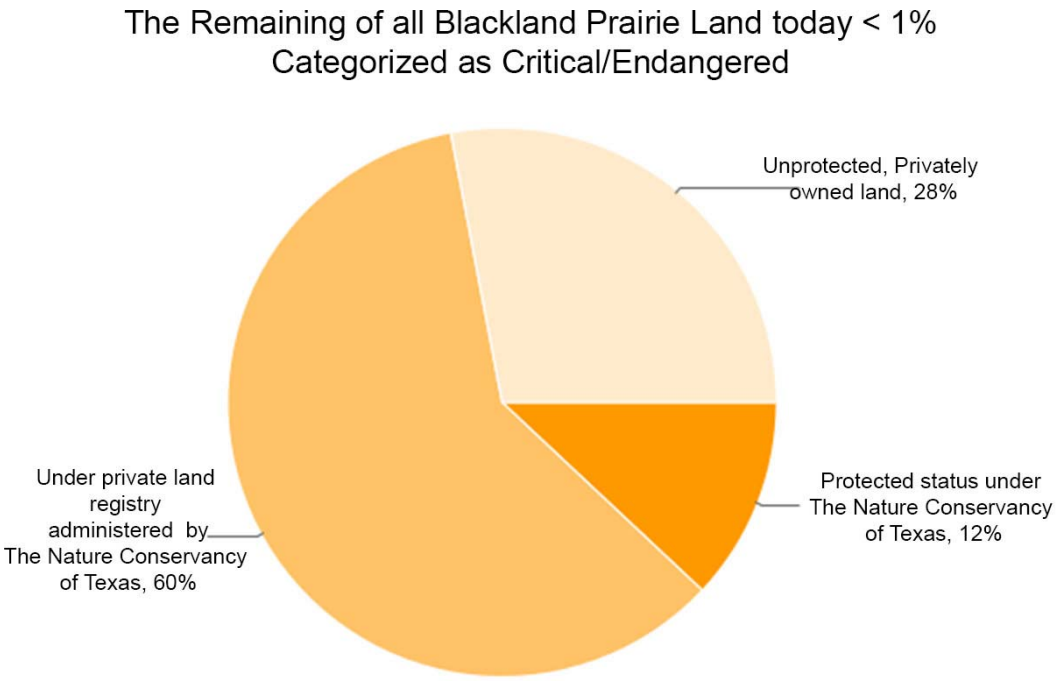


Figure 5. Remaining 5000 acres of Blackland Prairie is left in Texas ("Texas Blackland Prairies | Ecoregions | WWF," n.d.).

With less than one percent Blackland Praire remaining, the region is categorized as Tier 1, a high priority for conservation by the TPWD (Texas Conservation Action Plan (TCAP)," n.d.). All habitats within the Blackland Prairies are threatened by the following issues:

- Habitat loss by urbanization (sprawl),
- Row crop agriculture, and fragmentation,
- Invasive species,
- Population (rapid growth, development, and sprawl),
- Overhunting,
- Lack of public land, non-profit conservation land, and
- Private property (operated under wildlife management plans),
- Loss of tall grass prairie (birds have declined drastically), and
- Loss of critical stopover habitat (for migrant songbirds and wintering raptors).

The Cross Timbers region also faces imminent rapid land conversion and potential for increased fragmentation. Few large tracts of undisturbed woodlands remain in the East Cross Timbers region which is perhaps the most fragmented vegetative region in Texas. Many woodland areas in this region have been cleared for grazing, croplands, ranches, and both urban and rural developments. This includes portions of the cities of Denton, Dallas, Fort Worth, and other expanding inner-city and rural communities. Urban growth and expansion throughout this region will continue to impact wildlife habitat resources in the future, reports TPWD. Wildlife management will prove to be challenging to landowners and will require innovative approaches to management of the habitat resources found there ("TPWD: Texas Conservation Action Plan (TCAP)," n.d.). Also, in 2012, Texas gained the lead in crude oil production in the United States. Furthermore, U.S. oil production is expected to exceed that of Saudi Arabia by the end of 2017. This, in part due to the Barnett shale layer oil production which is one of the most important geological features located within Cross Timbers ("Home | Texas Land Trends," n.d.). Barnett shale oil production and the high population density of the DFW metropolitan area pose a serious threat to these regions ("Clymer Meadow Preserve | The Nature Conservancy," n.d.; Ewing et al., 2005).

The Cross Timbers region is categorized as a Tier 2, secondary priority for conservation by the ("TPWD: Texas Conservation Action Plan (TCAP)," n.d.) which states the following issues:

- Imminent potential for rapid land conversion
- Imminent potential for increased fragmentation
- Lowest rank in conserved status due to little public land, few private preserves, and a low percentage of private land under wildlife management
- Federally endangered Blackcapped Vireo, Golden-cheeked Warbler
- Federally endangered Comanche Peak Prairie Clover

In addition, the NCTCOG affirms that protecting ecoregions, prairies, woodlands, and remaining river corridors should be a priority (Vision North Texas).

2.2.3 Texas Conservation Action Plan (TCAP). Each state in the U.S has a completed Wildlife Action Plan or a Comprehensive Wildlife Conservation Strategy to improve the stability and recovery of species which are in decline. The primary purpose of TCAP is to bring people together to realize conservation benefits, prevent species listings, and preserve natural heritage for future generations. The plans are broken down into ecoregions and act as starting points to engage landowners, land-use planners, natural resources professions, and the public in regional and local community-based conservation ("Home | SITES," n.d.; Lehmann, 2011; Washington, n.d.). It is unclear to what extent they are used in the local regulation.

2.2.4 Summary. This section briefly stated the need for a landscape architecture focus on conservation. Research illuminates the rise in extinction rates due to biodiversity loss. This study is located within two ecoregions placed under Tier 1 and Tier 2 conservation need as described by the state of Texas, TPWD. Texas conservation plans are established. However, it is unclear to what extent local municipalities refer to those plans in local policy. This study offers a view of how CS may mitigate biodiversity loss by providing wildlife habitat focusing on apex predators as part of the solution. In part, a biodiversity-ecosystem framework views entire systems and their interrelated relationships (Maes et al., 2016). Tackling habitats from the view of apex predators expands the lens in which CS design incorporates an entire system rather than individual ecosystem services.

2.3 HIPPO

Concerning resilient design and biodiversity loss, ASLA writes, *"*Landscape architects can reconcile the needs of communities and healthy ecosystems to serve both ("Resilient Design: Biodiversity Loss | asla.org," n.d.). The profession is uniquely situation to address pressing issues of biodiversity loss by responding with resilient design practices concerning each issue. HIPPO and climate change are primary issues LA's may discuss in design development. The following section briefly describes HIPPO issues the profession may potentially affect in their field of work and through CS.

2.3.1 Habitat fragmentation. Forman (1995) defines a land mosaic as the spatial arrangement and "structure of a landscape or region (Figure 6). It determines the movements and flows between local ecosystems, and across the mosaic. It changes in form over time. Spatial arrangement is also a useful handle for decision-makers in planning, conservation, design, management, and policy." Mosaics are made up of patches and corridors which affect the metapopulation of species.

Fragmentation decreases the land connectivity that most flora and fauna depend upon to navigate those routes. New re-orienting strategies at the landscape level are required to respond to the challenges of biodiversity loss (Opdam & Wascher, 2004). Fragmentation divides natural areas and in effect, forces wildlife out of normal areas to hunt. Studies find that urban carnivores specifically shift hunting routines and ranges and are likely to seek the cover of nightfall when forced to venture out of their natural areas by fragmentation (Riley et al., 2003).

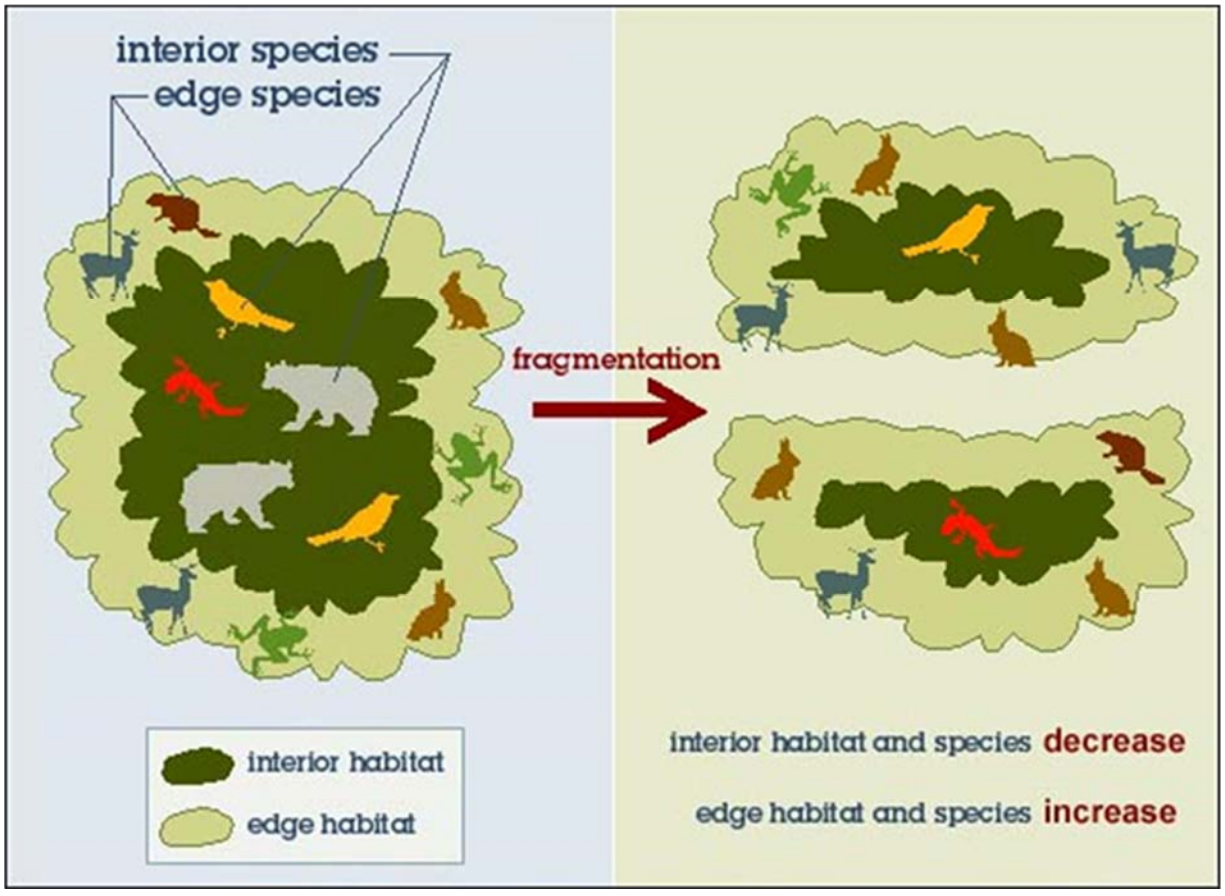


Figure 6. Fragmentation edge effects on species-Source:sustainablelinfield.edublogs.org ("The Effects of Climate Change on Mammals |Climate Change Resource Center," n.d.).

2.3.1.1 Road mortality. Fragmentation also increases wildlife mortality by way of mobility conflict on roadways (Riley et al., 2003). The Texas Department of Motor Vehicle states:

- A vehicular collision with some form of wildlife occurs, on average, every 39 minutes (26 seconds nationwide).
- One out of every 17 car collisions involves wandering wildlife.
- 89% of all wildlife collisions occur on roads with two lanes.
- 84% of all wildlife collisions occur in good weather on dry roads.
- The average repair cost of a car-deer collision is $2,800.
- Approximately 200 motorists die in the United States each year from car-wildlife collisions (Gaskill, n.d.; "Wildlife on the Road," n.d.).

Connectivity of habitat and permeability of road systems are found to be important factors. ("A review of mitigation measures for reducing wildlife mortality on roadways," n.d.).

2.3.1.2 Patches. Patches can be thought of as habitat islands (MacArthur & Wilson, 1967). Research indicates that patch area and isolation negatively affect many species. Patch dynamics influence the rate at which wildlife thrive or become extinct. Some patches may act as habitat sinks which may increase a patch population's extinction rate if they are unable to relocate ("FOR-75: An Ecosystems Approach to Natural Resources Management," n.d.; Forman, 1995). However, patch quality may lead to lower extinction rates from remnant patches for many of species that persist in urban settings (Prugh, Hodges, Sinclair, & Brashares, 2008). In fact, some species (such as birds and insects) are typically more affected by dispersal ability and habitat availability. For instance, grassland butterflies are limited more by the availability of suitable habitat than their ability to move among habitat patches. (Wood & Pullin, 2002). Specific to prairie habitat, preliminary results out of the University of Minnesota on prairie habitat fragmentation indicate that small flora populations have reduced fruit seeds and few pollen grains which support the hypothesis that pollinators are less likely to find and visit small patches ("Biology Laboratory Manual | Prairie Habitat Fragmentation," n.d.).

Flyways illustrate the need for patch habitat. North Central Texas Cross Timbers and Prairies ecoregions are part of the main United States Bird Central (Figure 7) and Monarch butterfly migration flyways (Figure 8). To enable species to navigate rapidly changing climates, conserving and restoring habitats to promote access to suitable climates is crucial to their survival (McGuire, Lawler, McRae, Nuñez, & Theobald, 2016). Connected landscapes allow wildlife (and mammals in particular) to seek appropriate habitats and prevent negative consequences of small isolated populations. Approaches particularly beneficial for native species given climate change and fragmentation include:

1. Maintain and if possible improve landscape connectivity,
2. Reduce stresses on current populations and habitats,
3. Maintain or improve current habitat for specific species,
4. Manage to maintain landscape diversity, and
5. Monitor change (“The Effects of Climate Change on Mammals | Climate Change Resource Center,” n.d.).

Currently, only 41% of the United States’ undeveloped land area is sufficiently connected to allow plants and animals to maintain mobility as the climate warms (Mckelvey, Perry, & Mills, 2013).

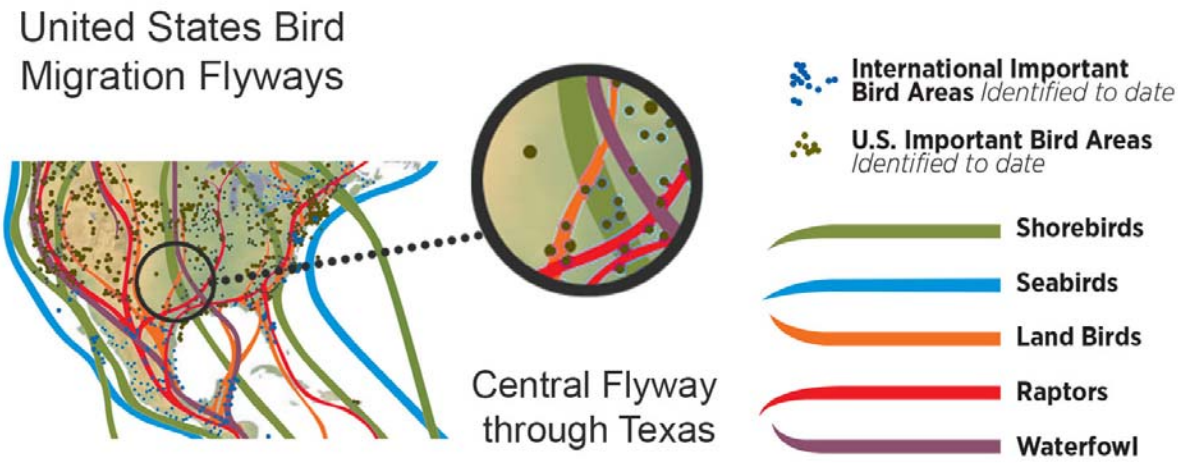


Figure 7. Avian species Central Flyway; cut-out through Texas (“ar2010-protectingtheflyways.pdf,” n.d.).

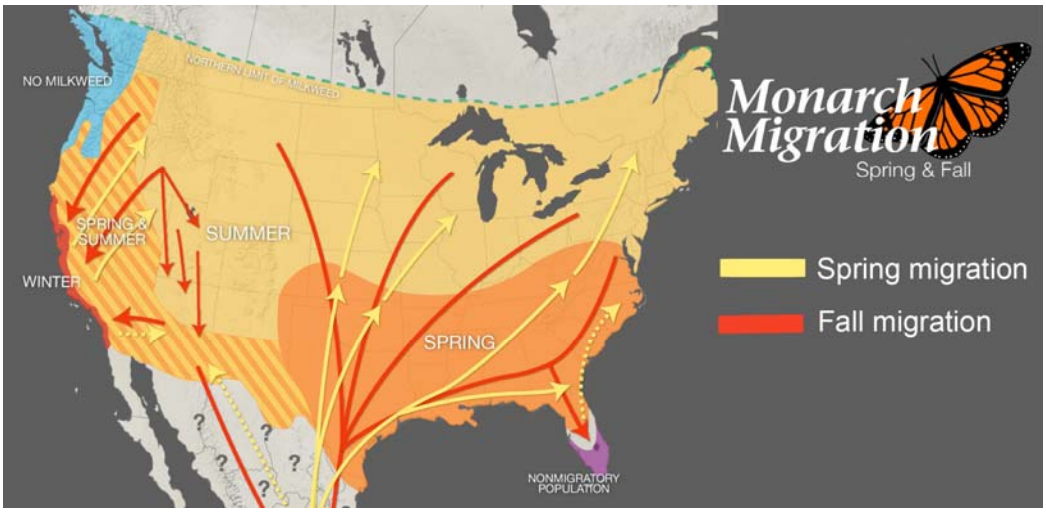


Figure 8. Monarch migration flyway from Mexico (“Monarch Butterfly Winter Season in Mexico,” n.d.).

Corridor connectivity and patch size and quality are key factors affecting habitat. Urban carnivores respond to changing conditions of the landscape. Furthermore, land mosaics are most often affected at the urban planning level. However, the Cross Timbers Conservation District in Flower Mound influences the decision-making process of design teams to maintain connectivity between CS.

2.3.2 Invasives. E O. Wilson claims that the introduction of alien species is second only to habitat destruction as the leading cause of extinctions worldwide (Wilson, 2016). A recent NASA report, announcing a unique effort to monitor the progress of alien species via satellite, placed the economic cost of alien species between $100 billion and $200 billion (yvette, n.d.). "Nonindigenous invasive species may pose the single most formidable threat of natural disaster of the 21st century," the report's authors warn (“The Truth About Invasive Species | DiscoverMagazine.com,” n.d.). "The threat of invasive species is perhaps our most urgent economic and conservation challenge. Invasive issues are mitigated by LA planting designs that incorporate native plants into their designs. Native plants furthermore, increase the availability of diverse food offerings preferred by local wildlife.

2.3.2.1 Monocultures. The additional practice of monoculture design compounds issues of biodiversity decline. Monocultures describe the practice of relying on a small number of plant varieties. This practice is heavily used in DFW and leads to widespread plant disease such as the case of Rose Rosette epidemic in North Texas that affects landscapes at the state-wide level (Chaturvedi, et al., 2010; “‘Rose rosette is an epidemic, and North Texas is the epicenter,’” n.d.). Permaculture design systems are used in farms and homesteads to encourage resilience and benefits that are found in natural systems. Polycultures are “plants of different species grown in the same patch…which share resources and form mutually-beneficial relationships referred to as guilds. They increase resilience, yields in smaller areas via vertical layering, and provide better habitat for birds and insects” reports Backyard Abundance, a non-profit whose mission is to help people create beautiful, environmentally-beneficial landscapes that provide healthy food and habitat (“Backyard Abundance,” n.d.). Polyculture use in landscape design is being studied on sites located at The University of Texas at Arlington and The Botanical Research Institute of Texas campuses (“Building a more resilient landscape with polyculture | Gardening | Dallas News,” n.d., “Future Viable Plant Palettes for Metropolitan Areas, Part 7 - Part 10 – The Field,” n.d.). Resilient design practices are being tested in response to growing needs of changing climate conditions and successful

habitats in our urban areas. Genetic diversity helps fight against plant disease (Gehrt, Riley, & Cypher, 2010).

2.3.3 Population. Sprawl is a way of life in American metropolitan areas. Land conversion for housing development is the leading cause of habitat loss and fragmentation (McKinney, 2006). North Texas cities are prime examples and play a heavy role in the phenomena. The DFW metroplex is the fourth largest metropolitan area in the country with four NCTCOG counties (Tarrant, Dallas, Collin, and Denton) being among the top 20 nationwide with the most population gain in the United States between 2014 to 2015 (Bureau, n.d.). *Endangered by Sprawl; How Runaway Development Threatens America's Wildlife,* reports that unless state, regional, and local practices are adapted, runaway development will deplete natural lands in metropolitan areas (Ewing et al., 2005).

The American City Business Journal projects the DFW area's population to rise 53.5% from 2015 to 2040, which translates to the seventh largest increase in the country. This increase places the population at almost eleven million people ("Database of ACBJ population projections through 2040," n.d.). Population growth also spills over into unincorporated areas as well. VNT projects as many as 89,000 people with 30,000 potential new housing units in unincorporated areas on the outskirts of DFW by 2030.

Development takes place at the urban fringe where the CS are located. A recent study published from WalletHub (Oct. 2016), using 14 key indicators of rapid economic growth from a period spanning 2009 to 2015 concluded that DFW suburban areas led in population growth with the City of Frisco in the number one spot nationwide. The cities of McKinney, Allen, and Flower Mound followed at numbers eight, 53, and 268, respectively (Bernardo, n.d.). Much of the projected growth surrounds the suburban cities of Allen and Flower Mound where all of the conservation subdivisions are located in the DFW area.

As sprawl encroaches into undeveloped areas which alters the land mosaic, urban carnivores take cover in remnant patches and subsequently move into newly developed areas to hunt. News reports reveal a rise in urban carnivore sightings in recent years.

2.3.4 Pollution and overharvesting. Ecosystem services targeted by LAs that potentially influence pollution include river bank areas along creek corridors and drainage systems. The issue of water quality is addressed in the design phase of conservation subdivisions which are introduced in

subsequent sections (Arendt, 2004; Arendt & Harper, 1996). Regarding the profession, the design for renewable energy and renewable materials is encouraged. However, overharvesting is beyond the scope of this study. Conservation subdivisions, by definition, address water quality in terms of retention or run-off and what type of infrastructure is developed. Water quality and drainage practices affect infiltration rates which in turn, affects the quality of vegetation and area water availability and quality for wildlife.

2.3.5 Climate change. Climate change is considered a key stressor on biodiversity and has been added to the list accompanying HIPPO. Trends towards higher temperatures and drought encourage wildlife to relocate to higher elevations above sea-level. Recently, NASA and NOAA declared 2016, the hottest year on record (Northon, 2016). Scientist project that North Texas will experience twice as many days of temperatures exceeding 95 degrees by 2050. During the twentieth century, mean annual temperatures increased by about one and one-half degree. Annual precipitation for the Great Plains was greater than normal during the last few years and freeze-free season length has been increasing since the early 20th century. Hot to cold extremes exhibit a significant amount of year-to-year variability ("U.S. Regional Climate Trends and Scenarios | National Centers for Environmental Information (NCEI) formerly known as National Climatic Data Center (NCDC)," n.d.). Climate change in Texas means flash flooding, depleted water resources, drier soils, higher temperatures and frequent drought which cause higher occurrences and severity of wildfires. As the regional landscape responds to changing climate, it transforms. Deserts may expand, and forests may shift to desert or grassland ("National Climate Assessment," n.d., "What Climate Change Means for Texas - climate-change-TX.pdf," n.d.). Long-term drought alters the delicate balance of natural ecosystems which become detrimental to fish and other wildlife species.

***2.3.5.1 Species mobility*.** Shifting vegetation (Figure 9) and fauna migration (Figure 10) take place under changing climate situations and ecological drought. As climates become unsuitable, the mammalian response, in particular, is expected to be rapid ("The Effects of Climate Change on Mammals | Climate Change Resource Center," n.d.).

"Researchers from the University of Washington and The Nature Conservancy modeled potential habitat for 2954 species using climate change projections and the climatic needs of each species. Using flow models, they plotted movement routes for each species, connecting current habitats with their projected locations under climate change" ("Migrations in Motion - The Nature Conservancy," n.d.).

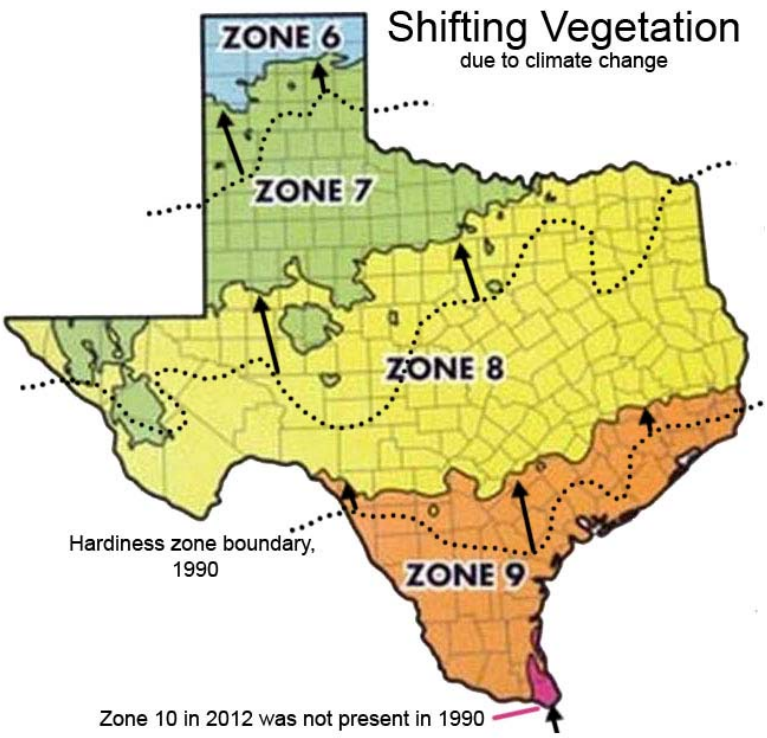


Figure 9. Shifting vegetation, due to climate change; 1990 to 2012
Adapted ("Texas Hardiness Zones," n.d., "USDA Plant Hardiness Zone Map," n.d).
Change("Migrations in Motion - The Nature Conservancy," n.d.).

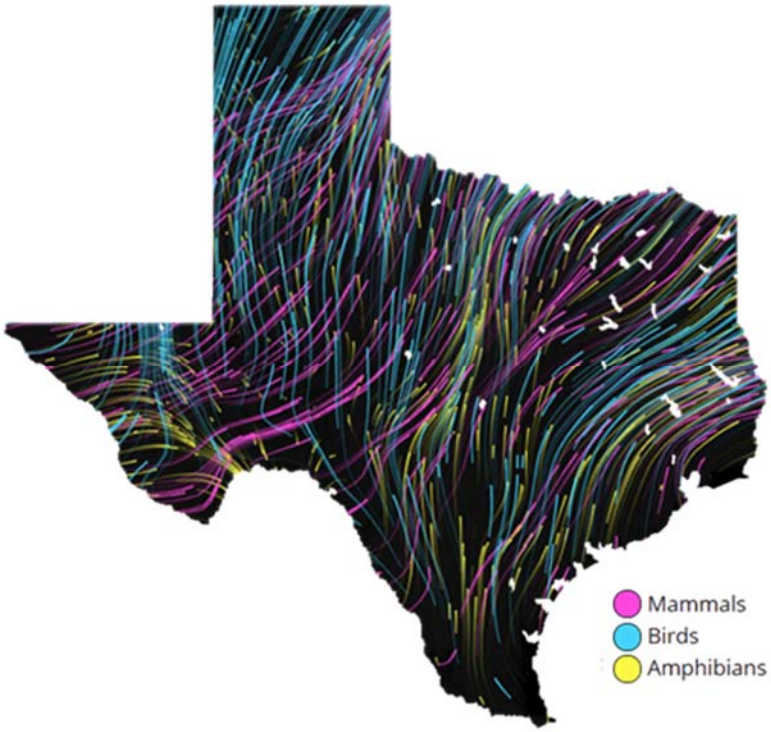


Figure 10. Migrations in Motion: Species Movement Due to Climate.

Figure 10 illustrates the projected migrations routes for mammals, birds, and amphibians under climate pressures. These migrations are projected under the assumption that wildlife can move to more suitable climates as necessary.

A key message presented in the National Climate Assessment, “Climate Change Impacts in the United States” concerning ecoregions and biodiversity informs that, “Landscapes and seascapes are changing rapidly, and species, including many iconic species, may disappear from regions where they have been prevalent or become extinct, altering some regions so much that their mix of plant and animal life will become almost unrecognizable.” Figure 11 shows projected (in white) and existing (in black) observed biological responses to climate change (corresponding numbered studies, see Appendix B, Groffman, et al., 2014). Kolbert states that as many as one-half of our species will be gone by the end of the century (Kolbert, 2014).

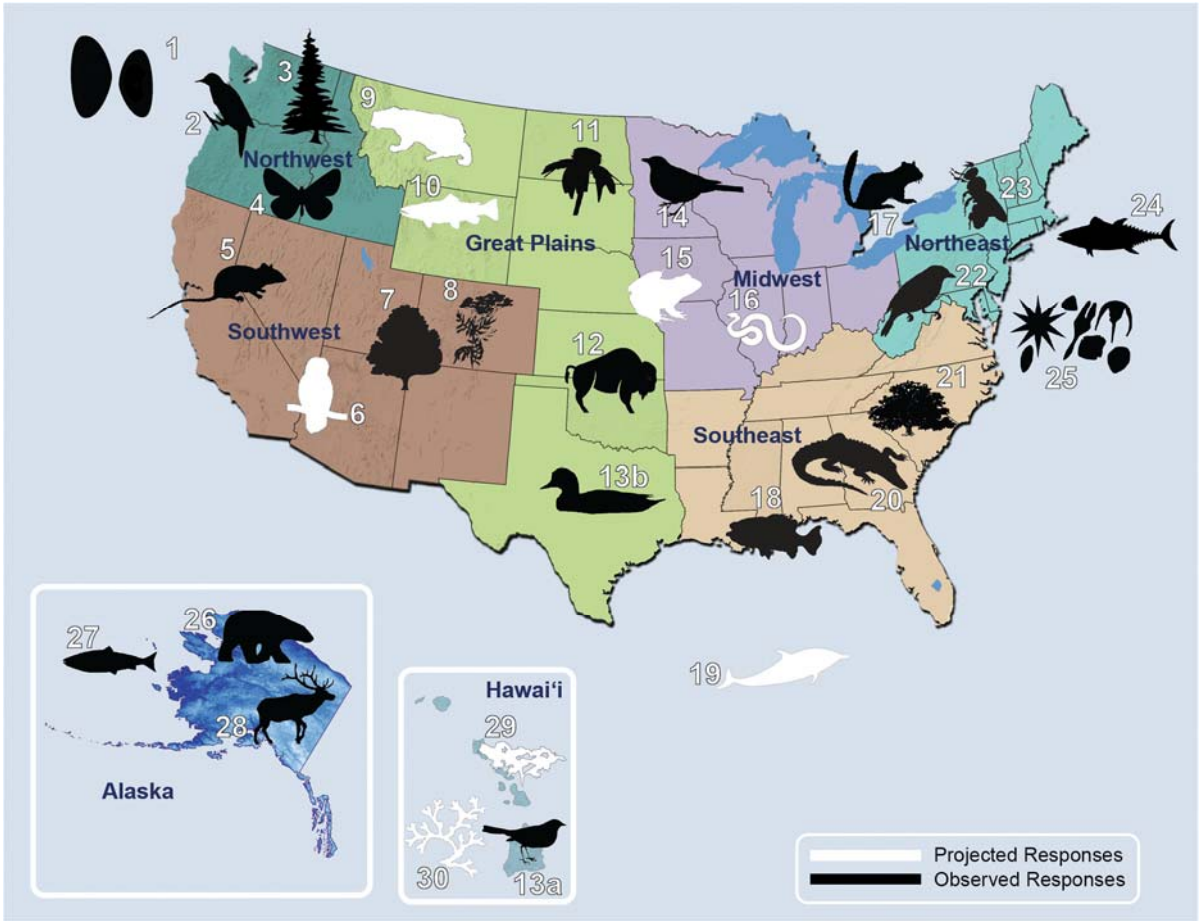


Figure 11. Biological responses to climate change across the United States, Appendix B (Staudinger et al., 2013; Groffman, et al., 2014).

2.3.6 Managing habitat threats. There exists a crucial interplay of the HIPPO threats: population growth (regarding sprawl and habitat loss), fragmentation, patch availability and connectivity for wildlife survival and mobility in response to changing climate conditions. As such, research is investigating these issues and yielding advice. Heller & Zavaleta, (2009) and Mawdsley, (2001), reviewed two decades of research covering biodiversity management in the face of climate change and identified several consistent recommendations for action. Collectively, they report that 70% of recommendations are not actionable. Lacking concrete strategies, biodiversity management stalls, therefore, they clarify the top actionable strategies as:

1. Increase connectivity (design corridors, remove barriers to dispersal, locate reserves close to each other, reforestation),
2. Design and plan new natural areas and restoration sites to maximize resilience, (integrating planning exercises to address reserves, pest outbreaks, harvest schedules, grazing limits, incentive programs),
3. Mitigate other threats and pressures on species and ecosystems from sources other than climate change, i.e. invasive species, fragmentation, pollution
4. Increase the amount of protected area,
5. Review existing laws and regulations,
6. Review monitoring programs, and
7. Question the wisdom of continuing to do things that are not working and will not work (Heller & Zavaleta, 2009; Mawdsley, 2011).

An additional strategy not mentioned in the previous study is the use of polycultures that are based on permaculture principles for building resilient flora relationships. Polyculture designs use many varieties of plants opposed to single masses used in monocultures (“Social Polycultures,” 2015).

Failed responses to climate changes can be readily attributed to few or inadequate implementation efforts made by communities. Many of these are due to inadequate post-construction maintenance and lack of education. Resolving those deficiencies can greatly increase the likelihood of successful implementation. In addition, Williamson, (2013) concludes that collaborative governance and adaptive management techniques (such as land bridges) designed to cope with fragmentation and uncertainty have obvious appeal. However, like many non-actionable strategies offered in response to climate change, both have failed due to inadequate implementation. Finally, responsibility to manage wildlife and their habitat is not based upon ecology, but rather jurisdictional boundaries (Glicksman, 2009). Successful conservation response in dense population areas can only take place with clear shared objectives among local, state, and regional governments. Bioregionalism is an environmentalist

movement in response to the preceding argument in which the purpose is to make political boundaries coincide with bioregions and will be discussed later in the review.

2.3.7 Land development trends and green infrastructure in North Central Texas.

Endangered by Sprawl (Ewing at el, 2005) advocates the position for widespread government support in efforts to conserve wildlife. The report assessed the extent and effectiveness of local government efforts to protect green infrastructure. The report noted that only three of the 15 metro areas assessed (Portland, OR; Minneapolis-St. Paul, MN; and Riverside, CA) have regional bodies with broad power over land use. Throughout the United States, local governments have adopted uncoordinated land use policies, with few strategies for ensuring that one jurisdiction's policies do not undermine the green infrastructure protection efforts of a neighboring jurisdiction in the same ecosystem. However, the focus of land conservation efforts has begun to shift. Leaders in government, nonprofit, and private sectors have increasingly begun work to protect natural resources closer to home. Vision North Texas to 2030, *Extending the Trends*, reports that there are no regional plans related to the future of North Texas' natural assets of habitat, plants, animals, open space areas and corridors, tree canopy or carbon footprint ("RegChoices_NorthTexas2030.pdf," n.d.).

NCTCOG and other agencies in the sixteen counties collaborate through meetings and discussions to formulate their contributions to regional plans. For example, as the DFW metropolitan planning organization, NCTCOG is required to maintain a long-term transportation plan (Mobility 2040). This document defines a vision for the region's multimodal transportation system. It also forecasts expenditures of state and federal transportation funds for the next two decades. In addition, NCTOG publishes the Integrated Stormwater Manual (iSWM), a document that provides the technical details to meet the requirements established by each community in their iSWM Manual ("integrated Stormwater Management (iSWM)," n.d.). The iSWM document details some landscape planning and design principles regarding aquatic habitats:

> "In some states, such as Washington, Oregon, California, Maryland, and Florida, a comprehensive (green infrastructure) plan is required by state law, and that plan must address open space. Local governments in these states typically perform far better in planning for green infrastructure than in other states, such as Texas, where open space planning is purely voluntary" (Ewing et al., 2005).

Without state or regional requirements of open space planning, Texas relies heavily on joint-ventures to conserve land under pressures of runaway development and population growth. The Texas Land Conservation (TLC) outlines additional issues that compete with conservation efforts specific to Texas. Ninety-five percent of Texas land is privately owned, three times more than any other state in the nation. Furthermore, the total acreage of protected land in Texas, including state and local parks, is only 3,000,000 acres (4688 square miles out of 268,597 total square miles in the state). Thus, Texas is losing its rural lands faster than any other state in the nation ("Texas Land Conservancy," n.d.). Without focused conservation efforts, some areas of Texas will be engulfed in development relatively quickly. Funding for public land conservation has decreased significantly over the past 40 years. On the other hand, the Texas Land Conservancy reports that private land conservation by land trusts has increased over fifty percent in the past decade. In 1996, the Texas state legislature created a new official land use category for wildlife management (for tax appraisal purposes). By 2012, wildlife management land use had increased to 2.37 million acres since the inception of this land use category. Categorizing land use for tax purposes does not necessarily increase quality habitat, however. Texas Land Trends also reports that the size of land tracts owned per individual is decreasing which potentially reduces patch size and quality.

2.3.7.1 Bioregionalism. The NCTCOG recognizes the need for a green infrastructure plan that could aid habitat conservation efforts. They state "the benefits of Green Infrastructure planning are tremendous" ("Environment & Development - nctcog.org," n.d.-a) however, to date, green initiatives have been published for reference, although no comprehensive plan is in place***.*** Thayer (2003) argues one of the limitations of conventional planning is its dependence on the market and policy is a response to development pressures through local political lobbying. He proposes that planning must be implemented at the bioregional level, taking into consideration ecosystemic social and physical planning. The growing importance of environmental issues forces regions to identify themselves within ecological regions of the land.

Flora and fauna fail to recognize political boundaries (Thayer, 2003), For example, once a rare occurrence, river otters are now more frequently seen in the Dallas area, and one was captured on video in 2016, at the Connemara Meadow in Allen, Texas ("River Otter may be making a comeback in Texas | Texas | Dallas News," n.d, Bob Mione Connemara Meadow Manager interview, 2017). Sightings of the apex or near apex carnivores in DFW suburban areas are a common occurrence. An inquiry of bobcat

observations on iNaturalist.org, March 21, 2017, revealed the following map (Figure 12,“Observations · iNaturalist.org,” n.d.). Thayer (2003) speculates that higher occurrences of sightings are a response to maximum patch habitat carrying capacity. Higher numbers of coyotes and bobcats can be supported in urban areas due to the availability of food sources. Research also indicates that urban carnivores adapt easily to urban conditions (Riley et al., 2003). For example, they change their hunting behavior to hunt during the nighttime hours rather than daylight due to the decrease in human activity at that time and tend to avoid detection. Bobcat iNaturalist sightings shown below reveal a majority of the sightings occurred along green creek corridor systems.

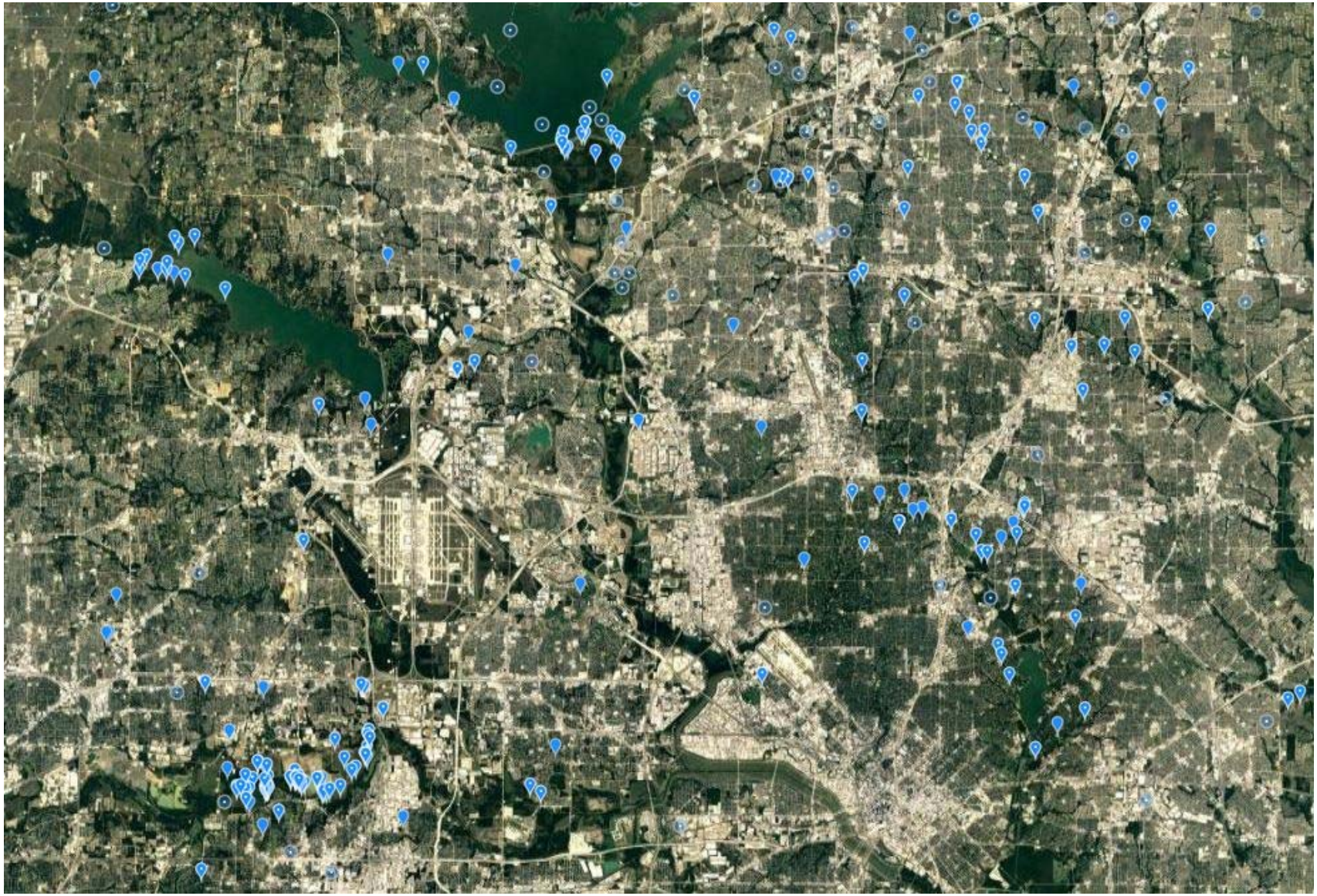


Figure 12. Bobcat observations in DFW surrounding areas, through March 21, 2017

Government policy directly affects how, what, and if conservation concerns are addressed. The NCTCOG does not possess a conservation plan, nor does it impose green infrastructure requirements as membership within the council is voluntary. Bioregionalism as a life-place approach to policy implementation was presented as an alternative to traditional policy models. Research supports the position that CD exist less frequently in regions with no clear conservation policy. Specific to Texas, a shortage of public land further complicates the issue of conservation

2.3.8 Conservation subdivisions toward Half-Earth Theory. Half-Earth Theory proposes what biologist, E.O. Wilson (2016), advocates to be a viable plan to save biodiversity: devote half the surface of the Earth to nature. To slow down the sixth mass extinction of species, including our own, *Half-Earth* argues that piecemeal conservation development does not work. Nonetheless, there is still time to put aside half of open space and even retrofit development to stave off mass extinction. Wilson identifies hot spots that he believes to be critical to biodiversity. Perhaps, the broad concepts may be applied to urban fringe development as well. Although the acceptance of new ideas and practices take place over time, it is shown that public opinion concerning conservation development is favorable in other areas of the United States ("Key Findings from National Voter Survey on Conservation : ConservationTools," n.d.). This literature review proposes that general conservation development practices are agreed upon in concept nonetheless lack actionable practice (Mawdsley, 2011).

Nature preserves and large green spaces in cities are a step towards implementing green infrastructure at city-level planning units, yet more can be done. Conservation subdivisions as previously defined, set aside half or more of buildable land as undivided permanent open space. Conservation subdivision development may contribute to the Half-Earth solution by taking into account the other half of the earth at urban scales where many biodiversity threats originate. Futhermore, Venhaus (2012) proposes integrated sustainable design strategies for small-scale sites and residential landscapes as an alternative to traditional design. To the extent they may mitigate environmental pressures, the benefits of sustainable small-scale sites are often treated as inconsequential and therefore overlooked (Venhaus, 2012). Integrated into residential sites within conservation subdivisions may potentially further mitigate'the other half' of Wilson's Half-Earth proposal. Conservation subdivisions and Half-Earth theory

are similar ideas from two distinct disciplines, and each of them calls for setting aside half of buildable land towards conservation efforts.

2.3.9 Summary. This section broadly outlined the issues surrounding the need for biodiversity conservation and the underlying concepts that drive conservation in metropolitan areas. In summary, cities are ecosystems, and ecological processes are at work and remain important in the urban environment. Extinction rates are accelerating at much higher rates than originally believed. Metropolitan areas experience substantial population growth which in turn causes rampant sprawl and rapid land conversion at the fringe areas of our cities. Climate change and fragmentation compound these issues and inhibit the ability of wildlife mobility. In response to widespread biodiversity loss, professionals in their fields have proposed the Half-Earth theory, sustainable sites integrated design, and education. LA's may potentially mitigate environmental pressures by way of CS development. By definition, CS protect land and wildlife habitat which may affect the presences of apex predators in suburban areas.

2.4 Conservation Subdivisions

Conservation subdivision development may, in part, help mitigate habitat loss. CS is a component of conservation design first introduced in the 1980's by the city planner, Randall Arendt. He combined the model of cluster development and open space design with McHarg's concepts of "design with nature" (Arendt & Harper, 1996, McHarg, 1992). This section examines the different aspects of conservation subdivisions as summarized by a publication of the Lady Bird Johnson Wildflower Center (LBJWC).

2.4.1 Importance. In most Texas cities, public transportation is limited, and cities are automobile dependent. Sprawl is the inevitable result, shifting building programs to focus on higher parking requirements and resulting in loss of pedestrian connectivity ("Mobility, Sprawl, and the Future of North Texas," n.d.). It manifests as urban fringe development in response to population growth. In turn, urban fringe development often destroys habitat for wildlife.

Conservation development is a process of development that adds opportunities to conserve and celebrate the local character and spirit of the place while achieving other goals. It is an approach to development that strives to balance the demands of a growing population with the need to conserve natural resources by way of preserving local flora and fauna. This method of development reduces the

influx of invasive species (Gabriel et al., 2005). Clustering development has also been shown to reduce negative impacts on wildlife habitat (Theobald et al., 1997). Pejchar (2007) describes conservation development as a possible method for providing ecological services in support of wildlife habitat and conserving or improving biodiversity (Figure 13).

2.4.2 Confusion in terms. The terms conservation development and conservation subdivisions are many times used interchangeably. As previously defined, conservation subdivisions are a type of conservation development (see operational definition in Chapter 1). Furthermore, some Texas cities have created what they label 'conservation districts' which may not be associated with actual conservation development as defined in this research. For instance, Dallas uses 'conservation districts' as a zoning tool to protect cultural characteristics in neighborhoods ("Conservation Districts," n.d.). Furthermore, developers may also engage in "green washing," a practice to promote the perception of green development whereas using green infrastructure practices may not, in fact, be implemented ("About Greenwashing | Greenwashing Index," n.d.).

Subdivisions are more often accurately characterized as "cluster" or "open space subdivisions" (Carter, 2009). Although the housing may use cluster placement, the units are not placed with sensitivity to the environment and area landscaping lacks concern for ecological soundness. To clarify, compared to conventional subdivisions, clustering focuses on lot placement, in which houses are placed in one area on the development to allow for open space elsewhere. Conservation subdivisions go beyond clustering in that they greatly reduce stormwater run-off due to large tracts of natural areas. Fifty to 70% or more buildable land, plus unbuildable wetlands, steep slopes, and floodplains are conserved.
In urban, sewer-served, high-density zoned areas and rural, urban fringe areas forty percent and seventy percent of land respectively is usually preserved. Rural and urban fringe areas tend to have densities of five to ten acres per dwelling whereas, in metropolitan areas, two to four units are built per acre. By clustering (in either cluster development or conservation subdivisions), the same number of homes can be built in a subdivision as allowed in conventional subdivisions n.d., Figure 14).

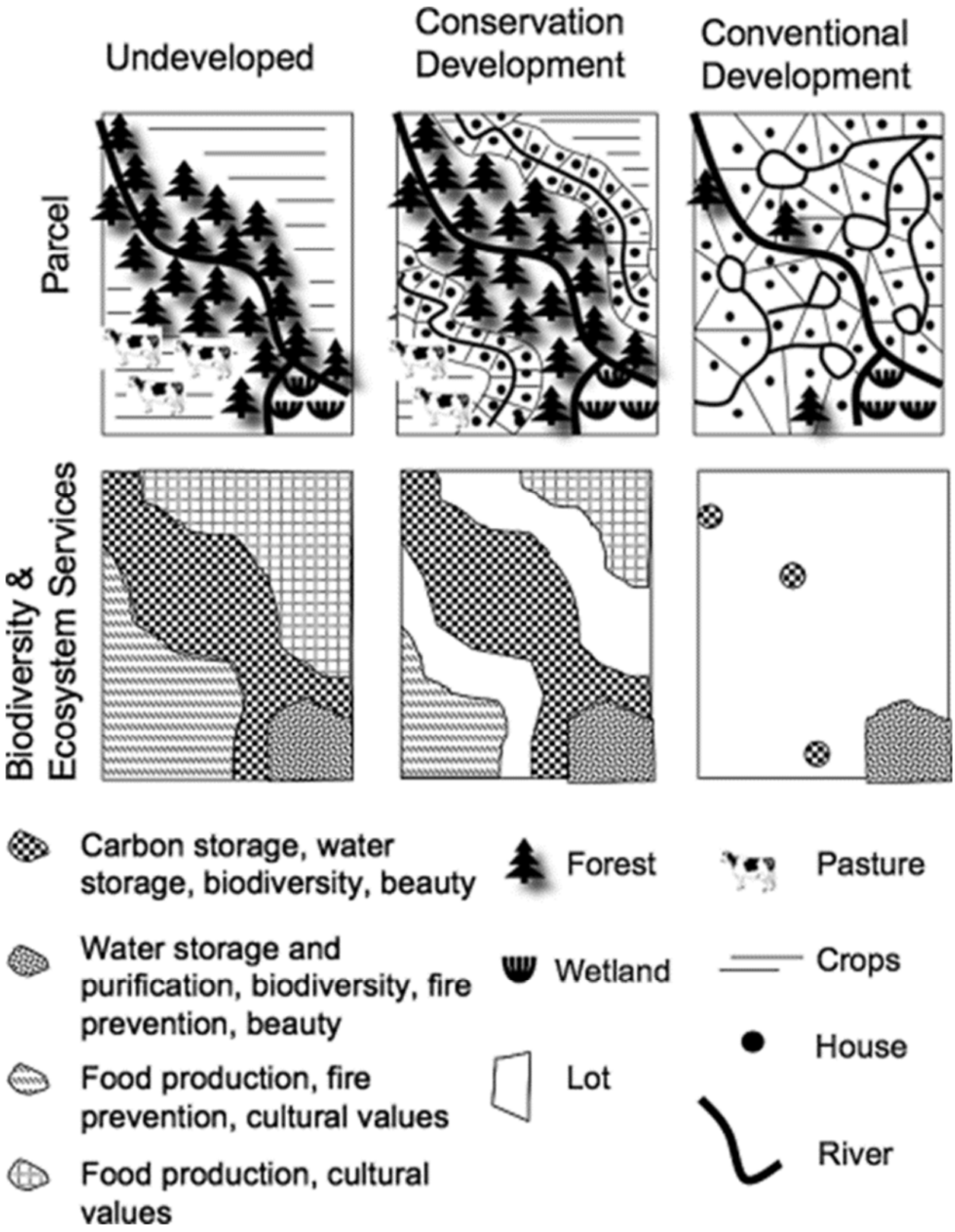


Figure 13. Comparison of land use and land cover and the ecosystem services provided (Pejchar et al., 2007).

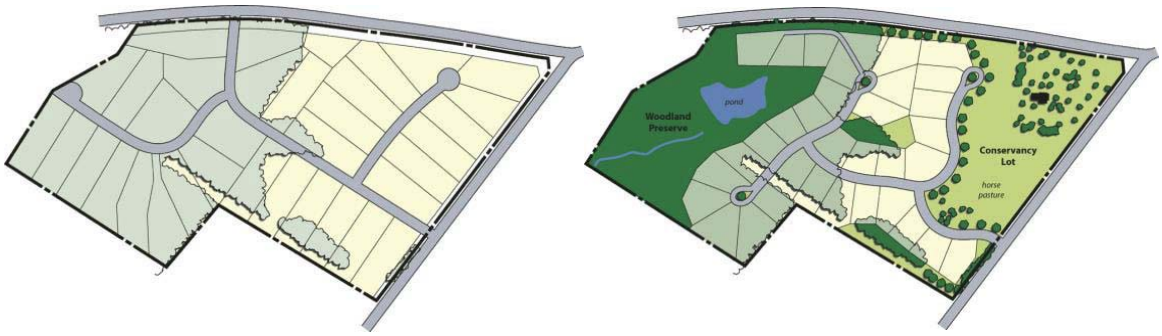


Figure 14. Density Neutral (Same number of lots);
Conventional vs. Conservation Subdivisions Stratford Hall, Weddington, NC; Design by Randall Arendt ("Selected Projects: Stratford Hall, Weddington, NC," n.d.).

Compared to cluster developments, conservation subdivisions have allowed:

- Higher Standards for quantity, quality, and configuration of resulting open space
- Greater influence on the design of new conservation subdivisions
- More interconnected land, so it contributes with interconnected networks of open space throughout the community, serving to link landscapes where possible (Arendt, 1999; "LandChoices: Conservation Development - learn how to preserve land and develop parts of it using conservation subdivision design," n.d.).

2.4.3 Models of CS. Many models of conservation subdivisions have surfaced over the past ten years. Models are modified and tend to reflect regional trends and specific concerns for an area or ecoregion. For illustration purposes, leading models that are often used as a preliminary starting place are presented in Table 1. Arendt's four-step process for designing CS include:

1. Delineating greenway land,
2. Locating house sites stormwater, wastewater locations, and potential development
3. Aligning streets and trails
4. Drawing in the lot lines
   (Growing Greener: Conservation by Design; National Land Trusts (Arendt, 1999), See Appendix B).

Criteria	Open Space Requirement	Min. Lot Size	Density	Ownership Or Management of Open Space	Comments
Arendt: No Min. Parcel Size	50% of buildable land. No more than 50% of open space should be used for active recreation.	n/a	Depends on underlying zoning for conventional subdivision. Density bonuses for establishing an endowment for maintaining open space, providing public access to open space and providing affordable housing	Open space may be owned by: 1. Homeowners' Assoc. 2. Condo agreement 3. Easement for public use. 4. Non-profit Conservation Org.	Arendt's model ordinance is more focused on the process of conservation development, rather than most others, providing guidelines for preliminary plans, consultations between interested parties, and analysis of existing features of the property.
U.S. EPA: 5 acres Min. Parcel Size	35%-50% of Buildable area.	May be reduced to 25% of base density but no smaller than 1/8 acre.	Depends on underlying zoning for conventional subdivision.	Open space may be owned by: 1. Homeowners' Assoc. 2. Condo agreement 3. Easement for public use. 4. Non-profit Conservation Org.	Makes conservation development a "by right" type of development. (www.epa.gov/owow/nps/ordinance/mol3.htm)

Table 1. Model Ordinances: Randal Arendt and U.S. EPA from LBJWC Primer
Additional model ordinances also presented in the Primer (Gabriel et al., 2005).

2.4.4 A definition of conservation development for Texas. New ideas and policy often need clarification to focus wide-spread efforts. In an attempt to sustain and encourage conservation efforts, the Lady Bird Johnson Wildlife Center (LBJWC) puts forth this definition of conservation development in Texas; "Conservation development seeks to reduce our ecological footprint by preserving significant, contiguous open spaces amid groups of clustered homes, which enhance sustainability through water conservation and energy efficient practices." LBJWC promotes the usage of this definition to be used by interested parties in developing policies that enable a more consistent and predictable application of the conservation development concept in Texas. The document outlines criteria recommendations for conservation development in Texas such as:

- Minimum parcel size
- Ecological analysis
- Open space requirements
- Density and lot sizes
- Impervious cover
- Narrow roads (road size)
- Viewshed and cultural practice protection
- Landscaping
- Building standards
- Utilities, and
- Long-term maintenance of open space (Gabriel et al., 2005).

2.4.5 Conservation subdivisions; regulation in Texas. To support decreased habitat destruction by lowering development density, Theobald et al. (1997) propose that regulation of subdivision pattern is required. This section investigates current regulation concerning conservation subdivisions in Texas. Texas cities, counties, and regional councils of government do not always work in concert. Wildlife habitat is by operational definition a regional concern. The individual efforts of one municipality may or may not be apparent or recognized by another.

2.4.5.1 Area Council of Governments and Metropolitan Statistical Areas (MSA). Texas is made up of twenty-four Texas Area Councils of Government (TACG) which serve the 254 counties that make up Texas. Regional councils or councils of governments (COGs) are voluntary associations of local governments formed under Texas law. TACG associations deal with the problems and planning needs that cross the boundaries of individual local governments or that require regional attention. The DFW metropolitan area falls within the NCTCOG. A sweeping yet, a limited search of Texas' COG and the Texas metropolitan statistical areas with populations exceeding 500,000 reveal the majority of

conservation development or subdivision ordinances available for review in the state center around the Austin metropolitan area. This search indicates that the Capital Area Councils of Government is the sole COG in Texas that addresses conservation development or subdivisions in their reporting documents (Appendix B).

2.4.6 Conservation easements. In Texas, where ninety-five percent of the land is in private hands, conservation easements are traditionally used to transfer land rights to a third party. Third parties are usually non-profit conservation organizations such as the Connemara Conservancy or the Texas Land Trust. These organizations assume the right to watch over and protect the land in the manner outlined in the articles of the easement (Merenlender et al., 2004). Currently, the transfer compensates the landowners and focuses almost exclusively on landowner and holder rights, as opposed to duties or organizations. As such, property-by-property conservation easement approach was found to continue fragmentation of the land. Hence, "the spatial scale of wildlife movement, almost always larger than ownership boundaries, requires a regional approach and speaks to the importance of coordinating a web of interests including non-profit, local, state and federal governance authorities," (Hilty, Jr, & Merenlender, 2012; Thayer, 2003). For example, in one case study of the Tenaja Corridor, individual acquisitions could not achieve habitat connectivity goals in the face of rapid urbanization threats (Rissman et al., 2007). While the seemingly apolitical approach of acquiring property rights has appealed to non-profit land trusts (Feldman & Jonas 2000), it does not harness the considerable power of regulatory authorities to enact a large-scale conservation vision (Rissman et al., 2007).

2.6.7 Perceptions of Conservation Subdivisions. As conservation subdivisions have become more popular over the past decade, several studies have been initiated to gain insight into how CS are perceived. The following chapter presents research findings on perceptions from both developers and residents concerning the benefit and barriers of conservation subdivisions.

2.4.6.1 ***Developers.*** Two studies examined the report on developer perspectives regarding their awareness of and their motivation for developing conservation subdivisions. Additionally, conservation practices and perceived barriers were discussed. Both studies took place in areas that have a higher occurrence of conservation development within the state (this search did not reveal any available Texas area studies). The Wisconsin study (Göçmen, 2014) interviewed sixteen developers while a Colorado study (Feinberg et al., 2015) covered 17 conservation developments.

Most developers were familiar with conservation design, and some had firsthand experience with their development. Motivations for conservation subdivisions varied as did their practices. However, more than half considered zoning and planning related factors concerning the permit process when deciding. Half considered the infrastructure savings associated with them, and half considered the demand for conservation subdivision homes. About a third identified physical land factors that influence their decision. One respondent said that if the area is flat, they use conventional development design. Furthermore, when deciding what to preserve, developers considered legal restrictions and ecologically significant lands (however, some also lacked the motivation to preserve lands). Finally, some mentioned using nature as an amenity and incorporated views and trails into the design layout. Perceived barriers discussed covered a multitude of issues such as:

- Lack of land use regulations that support conservation subdivision design,
- Reduced profit in the absence of a density bonus,
- Land cost more due to existence of natural resources on it,
- Common area maintenance issues
- Community opposition
- Lack of knowledge about sustainable residential development practices
- General lack awareness of conservation practices of by residents

In particular, one developer mentioned that the most natural way is most challenging unless people understand the expectation and that residents do not understand ‘prairies’ (Feinberg et al., 2015).

2.4.6.2 Residents. Thirteen communities across two studies were reviewed. Interview questions covered several major topics including resident maintenance open space. Overall, they were pleased with their community and subdivision. However, issues about difficulty organizing people surfaced frequently. Managing the common areas was problematic. Maintenance sometimes relied on landscaping companies, and some residents took it upon themselves to manage areas close to their homes. Pertaining to the physical settings, most expressed pleasure on openness and said that viewing natural settings was a benefit. Several used the words ‘peaceful’ and ‘quiet’ while describing their properties and liked the manageable lot sizes and shared spaces. A majority favorably mentioned social aspects and less than half mentioned some negative aspects such as rules not being followed and concern over future management. There were some complaints with regards to developers and transitioning to HOA.

When it came to residents' understanding of an open space conservation community, the term did not appear to be well understood. Some reported that open space meant common areas accessed by all. Only three respondents mentioned greater access to nature. Residents' comments did not articulate the underlying intention of the conservation subdivisions concept as an alternative to conventional residential development, and two people thought it meant having 'larger lots' opposed to smaller (Austin & Kaplan, 2010).

Researchers also found that high-quality riparian habitat adds value to nearby homes and that homebuyers do distinguish between biologically significant riparian vegetation characteristics (Bark et. al., 2009) In contrast, a study on the attractiveness of biodiversity revealed that high biodiversity did not relate to positive preference. It concluded preferences were about even for park open space and more complex vegetation. Ecological knowledge appears to have a positive influence on preference for certain aspects of biodiversity (Qiu et. al., 2013) so education may be a factor. It should be noted that the latter study targeted open space park preferences, not homeowner preferences., Residents in conservation developments do experience a higher level of satisfaction from nearby natural features than residents in conventional developments (Austin, 2004).

2.4.7 Lack of conservation subdivisions. Linking development to conservation design gives the opportunity to combat sprawl and habitat loss. Conservation subdivisions offer a clear opportunity to further conservation efforts and deter biodiversity loss. However, two challenges remain per Pejchar et al., (2007). First, conservation development will not achieve conservation goals unless these developments are designed specifically to protect and restore biodiversity and ecosystem services. Also, institutional changes will not occur until stakeholders recognize the full value of the conservation development approach. Additionally, for voluntary incentives to be effective, regulation to the contrary must first be eliminated. This is a necessary condition for CSDs to be successfully implemented. Since ordinance policy takes place at regional and statewide levels rather than local, it is difficult for conservation results to be reached absent regional direction and conservation planning (Arendt, 1999). Bosworth (2007) investigated why CSD is not more prevalent in the northeastern United States (where much of current CS development is found). The research identifies five overarching themes concerning barriers to the development of conservation subdivisions.

The obstacles uncovered are:

- Misconceptions about conservation design,
- Density-related issues,
- Market and performance uncertainty,
- Long-term management of open space, and
- Untapped educational and regulatory support systems (Bosworth, 2007).

Furthermore; developers and potential residents will not be convinced until they experience more local examples (Pejchar et al., 2007). The amount of private land ownership in Texas presents an added dimension to the difficulty in implementing conservation subdivisions. This may be the reason why research on CS in Texas is limited at this time.

2.4.8 CS in Cross Timbers and Blackland Prairies, North Texas. Chimney Rock and The Sanctuary built by Willard Baker, were the first conservation subdivisions in North Texas. Willard learned of Arendt's four-step design approach to conservation subdivision development through a seminar offered through the City of Flower Mound. Willard consulted Arendt in the site survey phase for aid in identifying conservation areas, streets, trails, and lot lines. At the time (2002), only one other conservation subdivision in Texas (San Antonio) had been developed close to completion, stated John Davis, an urban biologist with the Texas Parks and Wildlife Department. Davis expressed support for conservation subdivision design stating, "I think conservation-designed projects like Chimney Rock are the way to go in the future…It's a way to accomplish economical, ecological and social goals all in one. I think once developers really see the benefits, this will become the norm. We'll start to question why developers aren't doing it this way. It makes too much sense."("Developer attracted to clustering concept," n.d.). Since 2012, a few more subdivisions have surfaced in North Texas (Appendix B). Randall Arendt also provided expertise as site designer to the subdivision known as Montgomery Farms and Watters Creek in Allen, Texas (Arendt & Brabec, 1994). John Davis was an interview participant to the current study, and he has since reversed his view on conservation subdivision development, stating, "they increase sprawl."

Two North Texas cities lead conservation development in the NCTCOG. The City of Flower Mound in Denton County and the City of Allen in Collin County are similar in that these cities have a history in focused planning for open space and conservation efforts. Flower Mound, for instance, has an Environmental Conservation Commission (ECC), that focuses on open space, conservation, water quality, and sustainability practices, among other areas. Furthermore, Flower Mound has established the

Cross Timbers Conservation Development District (CTCDD) that is a “predominantly residential development, typically being single family residential development on two-acre lots or greater in combination with conservation easements and other conservation techniques that preserve the Cross Timbers ecosystem and other natural systems.” The City of Allen focused efforts on linear greenbelt park studies starting 1986 and is sometimes referred to the city of greenbelts. It is part of the larger Collin County Regional Trails Master Plan (“Parks & Open Space,” n.d.).

A search of the U.S. National Easement Database revealed five conservation subdivisions within the study area, all with easements governed by the Connemara Conservancy. Further examination of the easement intent and purposes provided by the Connemara Conservancy database uncovered the following data regarding the purpose of each conservation easements (Table 2).

2.5 Designing Conservation Subdivisions for Wildlife

Reed (2014) examined 414 counties in the Western Untied States and determined that only thirteen percent of the West’s conservation development ordinances mandated a study of the property’s ecological attributes and only eight percent of CD ordinances encouraged consultation with a biological expert or compliance with a conservation plan in the design phase. Additionally, researchers found that once built; few ordinances required any post-development oversight and that this typically is left to the HOA. They also found that in Wyoming and Colorado, in particular, that the conserved land may be re-opened for development after 65 and 45 years, respectively (Reed, Hilty, & Theobald, 2014). Without deliberate focus and attention to all phases of the design process during the development of conservation subdivisions, success cannot be attained (D. F. and M. Hostetler, 2016; M. Hostetler, 2010; M. Hostetler & Drake, 2009). In contrast, however, Theobald et al. (1997) studied cumulative effects of development using natural resource management and land use planning and found that cluster development, reduces negative impacts on wildlife habitat. This study concludes that landscape pattern or (land mosaic) was a larger indicator of disturbance than density. Pejchar et. Al., (2007) suggest that ecological impacts of development can be reduced by modifying several dimensions of development design for counteracting habitat loss. The first are in the design phase; site selection, housing density, and landscape design. The second is land management, post-construction. These are discussed in the following section

Name & Developer	**County/ Region/ Year**	**Easement Acres & Total Acres**	**Easement Holder**	**Conservation Purpose & Land Use *(refer to numbered list below)**
Chimney Rock CE-1, Chimney Rock CE-2, Flower Mound, Willard Baker, '02-07	Denton, Cross Timbers, 2002	49/100	Connemara #985849	*1, 2, 3, 5 Preserve wooded areas, riparian corridor, native prairie Pastureland Ranchette w/residential envelope
The Sanctuary, Flower Mound, Willard Baker, '03-?	Denton, Cross Timbers, 2003	45/99	Connemara #985926	*1, 3, 4, 5 Protect forest & savannah
Montgomery Farms, Allen, Emerson Partners, Inc, '05-ongoing	Collin, Blackland Prairie, 2005	145/650	Connemara	*1, 2, 3, 4 Protect conservation tract (Adjacent to 72 acres Connemara Meadow Preserve)
Montalcino Estates, Flower Mound, '12-on-going	Denton, Cross Timbers, 2012	142/284	Connemara #985903	*1, 2, 3, 4, 5 Cross Timbers, grasslands, riparian corridors and stock ponds. Easement will contain an equestrian trail system and potential hiking trails.
High Meadow CE-1, 2 Flower Mound, '14-on-going	Denton, Cross Timbers, 2014	16/32	Connemara #985885	*1, 2, 3, 5 Wooded areas, riparian corridor and native prairie adjacent to lots in the conservation subdivision

***Conservation Purpose and Land Use Easement Legend**

1. Protect the relatively high-quality **habitat for wildlife, native plants** and similar ecosystems on the Property;
2. Conserve the **water quality** and **riparian values** on the Property;
3. Preserve the **open space** on the Property where such preservation is for scenic enjoyment;
4. Preserve the land areas and on the Property for non-intensive outdoor **recreation** by the public (Public trail corridor to promote outdoor recreation for public benefit)
5. Pursuant to **local conservation policy** (Town of Flower Mound)

Table 2. Conservation Subdivisions within Cross Timbers & Blackland Prairies, North Texas ("CCF Easements," n.d.,).

2.5.1 The Sustainable Sites Initiative and habitat design. There are land development certification organizations as well as those affiliated with governmental agencies that promote green land design. One such initiative that is gaining popularity in the U.S. is the National League of Sustainable Development Sustainable Sites Initiative. The initiative leads design fields in developing guidelines for sustainable land practices that are grounded in science. It is based on principles of green urbanism and includes benchmark sections on conservation subdivisions and wildlife habitat and publishes model ordinances and guidelines for sustainable development (Lehmann, 2011; "Model Ordinances & Guidelines for Sustainable Development," n.d., "The Case for Sustainable Landscapes - The Case for Sustainable Landscapes_2009.pdf," n.d.).

SITES V2 Rating System guiding principles ("Home | SITES," n.d.) related to habitat include do no harm, design with nature, support the living process, and foster environmental stewardship. The framework focuses on ecosystem services and mentions conserving habitat for threatened and endangered species (Section 1). Specific to habitat functions and pollination, the ecosystem services targeted are providing for the reproduction of crops and other plants and providing refuge and reproduction habitat to plants and animals, which contribute to the conservation of biological and genetic diversity and evolutionary processes. Providing habitat is stated to be one of the foundational goals of SITES in creating regenerative systems that foster resiliency. Particular attention is given to the site context which should be sensitive to wildlife habitats and features that provide essential ecosystem functions for wildlife. Soil and vegetation management are targeted to potentially increase the quality of habitat (Section 4). Credits are specifically given for conserving aquatic ecosystems, habitats for threatened species, using native plant communities, avoiding invasives, and optimizing biomass. There is also credit for minimizing chemical use (Section 8). While SITES fails to address specific overall fauna of an area, it does score for a pre-design site assessment which should (in theory) include wildlife in that area. It also rates for minimizing fire risk (Section 4) which may potentially be in conflict with top tier level mammals since they prefer understory cover (Gehrt, Riley, & Cypher, 2010). Light pollution is addressed under human health (Section 6). However, it also affects movement patterns in urban carnivores (Gehrt et al., 2010). Finally, it scores for education and performance monitoring plans (Section 9) which research shows is inadequate and needed for the success of wildlife habitat conservation (M. Hostetler, 2010; M. Hostetler & Drake, 2009).

2.5.2 Landscape for Life. The Landscape for Life is a program, an offshoot of SITES and supported through the LBJWC is geared towards small-scale, residential sites. It teaches that conventional gardens often work against nature by damaging the environment's ability to clean air and water, potentially increases flooding, and contributes to climate change. Its objective is to provide a process to small scale site designers to aid the increase of ecological benefits that support life and biodiversity ("About," n.d.). The 2017 trainer directory shows classes offered in the DFW area through three cities (including City Beautiful and water districts), six area volunteer organizations focused on ecoregion, and fifteen area businesses and gardens.

2.5.3 Conservation for wildlife habitat. To maximize the potential of conservation subdivisions to conserve wildlife and their habitats, and to promote positive wildlife experiences by residents, Hostetler & Drake (2009) identify requirements in the three phases of development. The review outlines pertinent issues related to these phases of development; design, construction, and post-construction.

2.5.3.1 The design phase. The design phase in conservation subdivision development includes a four-step process as defined by Arendt & Harper, (1996, Appendix B):

1. Delineating greenway land, stormwater, wastewater locations, and potential development
2. Locating house sites
3. Aligning streets and trails,
4. Drawing the lot lines.

The objective is to permanently protect a significant percentage of buildable land in such a manner as to create interconnected networks of conservation areas. Conservation focus with an intention on wildlife habitat requires an exhaustive inventory. The objective is to conserve native plants within small and large natural remnants, and to inventory habitats, plant and animal species (Arendt & Harper, 1996). In addition, wildlife surveys should be conducted during spring, summer, fall, and winter as species detection can be season dependent (Hostetler & Drake, 2009). Often overlooked in the design phase is how individual yards and landscaping provide valuable habitat for wildlife (Bender, 2009; Rudd, Vala, & Schaefer, 2002; Venhaus, 2012). Likewise, using native plants attract a wider variety of wildlife species in urban areas than non-native plantings (Mills, Dunning, & Bates, 1989; "The Case for Sustainable Landscapes - The Case for Sustainable Landscapes_2009.pdf," n.d.).

Common areas, stormwater retention ponds, and yards may have ill effects on wildlife diversity if the conserved open spaces contain invasive exotic plants that transform the natural habitat into non-

native areas (McKinney, 2002, Pimentel et al., 2001). The flora and fauna surveys, wildlife management objectives, habitat implementation, management strategies, and plan evaluation should all be summarized in a written wildlife management plan that is kept on file at the site for future reference once the neighborhood is built (Arendt & Harper, 1996).

The design phase inventory should strive to understand landscape ecology concerning edges, where two or more vegetation types or age classes meet as it has implications for wildlife diversity as well. Increased edge habitat called 'edge-effect' may increase certain problematic wildlife species creating unwanted human-wildlife conflict. (Conover, 2001; Dramstad et al., 1996). Attention to corridors is also important as they aid wildlife to move between larger patches of habitat (Arendt, 2004; Dramstad et al., 1996, 1996; Rudd et al., 2002). Both 'passage species' and corridor dwellers' as their names would indicate, make different uses of corridors (Beier & Loe, 1992). As the design phase concludes and construction ensues, attention to ecological processes remains essential. Specifically, urban carnivores with large home ranges prefer natural areas with understory vegetation they can utilize for cover (Gehrt, Anchor, & White, 2009; Riley et al., 2003).

2.5.3.2 The construction phase. "The preservation and restoration of indigenous species in and around developments is key to minimizing conservation impact and adding ecological value" (McKinney, 2006; Pejchar et al., 2007). Unfortunately, it often happens that after the design phase ends and development moves into the building phase, contractors, and landscapers fail to implement the design as intended. Habitat protection and on-site management are crucial yet often overlooked when it comes to protecting the area habitat during construction. In fact, developments may even function as ecological traps if not carefully implemented (Battin, 2004). Ecological traps are habitat sinks that may potentially drive a particular patch population to extinction due to maximizing the patch's carrying capacity (Forman, 1995). Concerning, flora, trees are a prime example of one of the most common casualties to construction as tree roots under their driplines are not often protected (Watson & Neely, 1995). During construction, the focus should remain on the protection of water bodies and natural assets from damage and pollution (M. Hostetler & Drake, 2009). As plans progress into reality and maintenance of the built subdivision and protected areas change hands, the focus should also transition. Post-construction launches the upkeep cycle of the development that results in a distinctive set of needs.

2.5.3.3 The post – construction phase. As noted above, impacts stemming from built areas could compromise the intent of the CD to conserve biodiversity. Researchers and practitioners suggest that for a CD to maintain long-term biodiversity, it needs to have a management plan that assigns stewardship responsibilities to residents or outside entities such as a land trust (Arendt 1996; Pejchar et al. 2007). Post-construction studies have shown that homeowners living in conservation subdivisions do not understand the concept of open space and are not aware of appropriate management practices to maintain wildlife habitat and may resort to environmentally insensitive behavior (Youngentob & Hostetler, 2005). Furthermore, management plans are not usually well defined and funding tools not established (D. F. and M. Hostetler, 2016; Romero & Hostetler, n.d.). Based on resident interviews, Austin & Kaplan (2003) found that several barriers to resident involvement in post-construction management existed. These were primarily

1. Conflicting values on nature areas,
2. Low resident participation, and
3. Challenges in obtaining appropriate information.

Values on nature areas were found to conflict based on resident preference for manicured areas versus “a certain look” sometimes based on “tree lines.” Residents expectations often run counter to how many conservation areas look.

Low resident participation included low resident activity or concern regarding conservation needs. In addition, challenges in gaining accurate information for conservation include no support system for obtaining that information. Researchers recommend tools for post construction to include programs in natural resource management and education as well as programs that enhance community partnerships and communication that aid in gaining knowledge and involvement of open space management (Austin & Kaplan, 2010). Other studies suggest that programs should also lead toward areas such as avoiding invasives and using natives, wildlife conflict, and living alongside urban wildlife.

Studies by Hostetler & Drake (2009) recommend that:

- Developers should set up a funding mechanism to support open space management over the lifetime of a community,
- Developers should implement an on-site, robust education program that would address wildlife issues and conservation and would describe best management practices (and the importance thereof) for maintaining the biological integrity of the conserved areas.
- Project sales offices should set up education concerning concepts of land and also be visible in the neighborhood long after the sales office is closed.

- Project developers should further implement a program for the evaluation of wildlife management objectives identified during planning to help identify new solutions and that
- Community Codes and Restriction (CCR) documents need to contain language for both the management of individual lots and conservation areas.

To respond to the issue of sustained construction and post-construction habitat quality, Hostetler outlines critical factors affecting wildlife habitat specific to these phases of green development that should be avoided. They include:

- Excessive irrigation,
- Excessive fertilization and pesticide use,
- Spread of invasive plants and animals,
- Replacement of native landscaping with exotics,
- Improper management and care of Low Impact Design features,
- Disruption of flora and fauna by vehicles and foot traffic in conservation areas,
- Underground seepage from septic tanks (in rural subdivisions),
- Increase of animal aggressiveness and lack of fear due to humans feeding wildlife, and
- Conflicts with natural area management practices such as the need for prescribed burns.

He advocates the way forward is through planning and policymaking efforts enabling conditions to improve the uptake and implementation of sustainable development practices. Construction and post-construction phases must not be over-looked if habitat conservation is to succeed. He argues that most failures are due to policies developed without the involvement of important stakeholders and the incentives are not viewed as true incentives for the affected parties. He states that green practices are perceived as costly. Breakdown also arises with the lack of education or sufficient marketing plans stating, “Success is ultimately contingent on whether developers and environmental consultants are engaged. Discerning developers should hire only consultants that are aware of proper construction and post-construction techniques,” (M. Hostetler, 2010; Romero & Hostetler, n.d.).

Grounded in a review of Arendt's criteria and wildlife needs for habitat, Hostetler & Drake (2009) present a checklist schematic of key design, construction, and post-construction issues to be tackled when creating functional wildlife habitat in conservation subdivisions (Table 3). It addresses key issues that require attention within each phase of design to maintain focus on habitat. Research exposes a lack of focus on habitat conservation within conservation subdivision design. Wildlife habitat is cited as a key conservation objective. However, quality effort is not maintained. Answering questions on the following checklist schematic of key design, construction, and post-construction issues related to CS development would direct efforts towards increased quality habitat conservation and design practices. For the purposes of this study, the wildlife targeted are urban carnivores as apex predators that require a look at

entire systems. Hosteler and Drake's checklist includes a complete flora and fauna inventory which should include all fauna in the participating food web.

DESIGN PHASE: 1. Have seasonal flora and fauna inventories been conducted? 2. Have wildlife management objectives been defined? 3. Is a written wildlife management plan in place? 4. Size and distribution of conserved open space: are edge habitat a concern regarding problematic wildlife species? 5. Are wildlife corridors necessary? If so, for which species? 6. Are surrounding built areas specifically designed to minimize the impact on conservation areas?
CONSTRUCTION PHASE: 1. Hired trained and motivated contractors and other built environmental professionals? 2. Hired a conservation-minded site manager? 3. Appropriate fences and barriers installed and maintained to protect conservation areas and native vegetation? **4.** Monitoring and management practices in place to control invasive exotics and wildlife/human conflicts?
POST-CONSTRUCTION PHASE: 1. Installed a long-term environmental education program for homeowners? 2. Have funding for long-term management of the open spaces? 3. Evaluation of the success of wildlife management objectives? 4. Environmental language in the community codes and covenants? 5. Management plans that address potential wildlife/human conflict?

Table 3. Development Phases; A conservation subdivision wildlife habitat checklist, adapted (M. Hostetler & Drake, 2009).

In part, the research methods and interview topics for this study have been derived from Hostetler's findings and are presented in Chapter Four.

2.6 Urban Carnivores

Urban carnivores include a variety of organisms that kill and eat other animal species (Gehrt et al., 2010). For the purpose of this study, an urban carnivore refers to the top-level apex or near the apex level mammalian land animal (Figure 15). Specific species to North Central Texas are coyotes and bobcats. Bonnie Bradshaw, a Texas Master Naturalist and owner of 911Wildlife (eviction services) whose mission is to prevent native wildlife from being orphaned, injured, relocated or euthanized states they receive daily calls on coyotes and bobcats throughout the entire DFW metropolitan area (personal correspondence). Texas Wildlife Services through Texas A&M AgriLife office report a continuous

increase in coyote sightings (Lynette, 2015) and the City of Richardson is experiencing a bobcat boom along Canyon Creek ("Bobcat boom," 2016). The rise in sightings is believed to be in response to widespread fragmentation and the high adaptability of these carnivores to urbanized habitat. Urban coyote populations are often thought to exist at higher densities in cities compared to their nonurban areas due to food resources (Gehrt et al., 2010, p. 82).

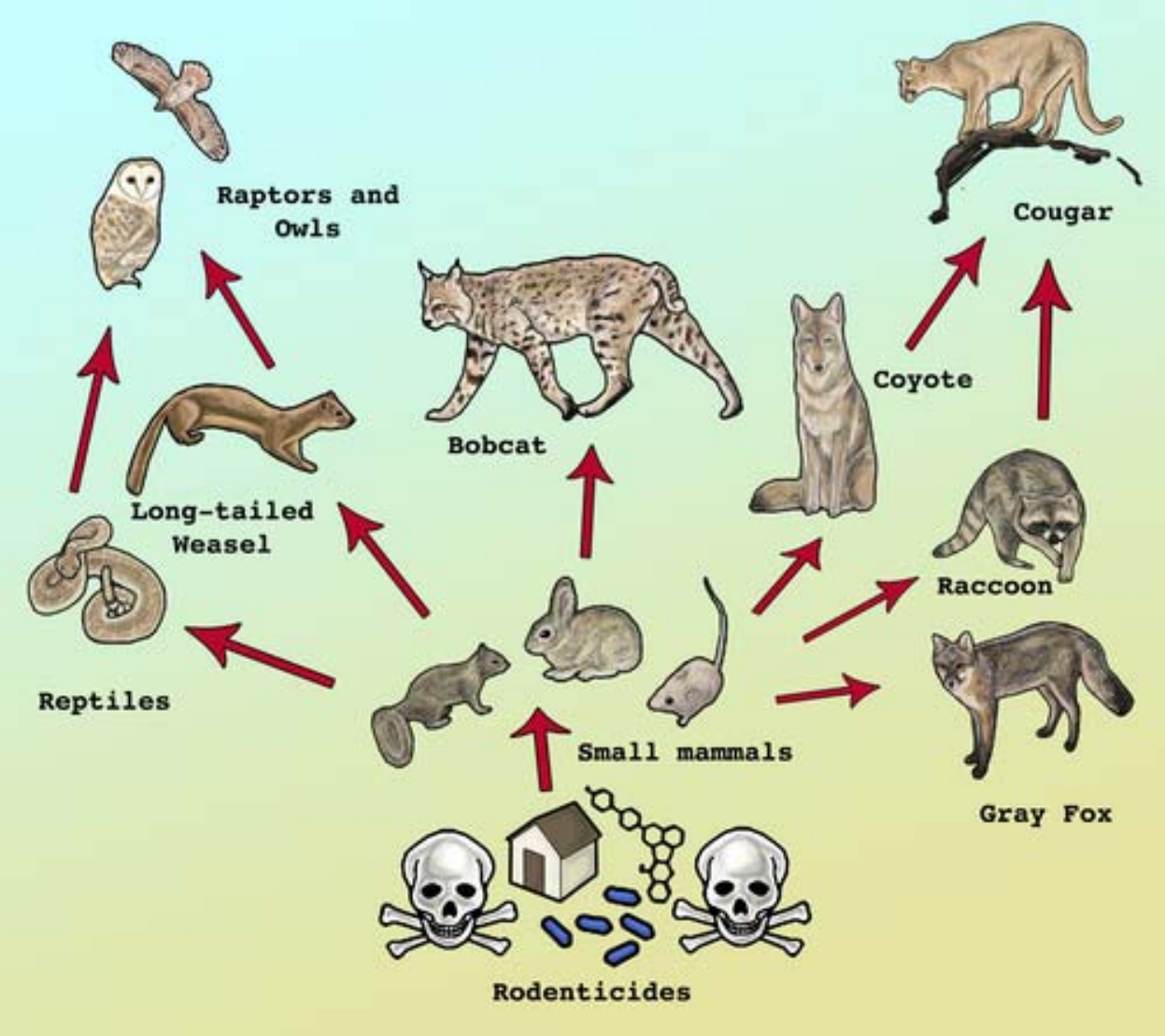


Figure 15. Urban food chain
(Source: UrbanCarnivores.org)

2.6.1 Landscape use and selection. Urban coyotes and bobcats tend to center their territories within natural habitat patches. On average, urban coyote and bobcat home ranges consist of about 75% and approximately 66% natural areas, respectively (Riley et al., 2003). Urbanization could be affecting

home range size in two different ways where development reduces home range sizes and increases overlap (Riley 2006). Urban coyotes and bobcats tend to adapt their movement patterns in response to road crossings. Research has shown that 52% of coyotes cross major secondary roads yet only 5% cross major highways (Riley et al., 2006). It has also been shown that urban carnivores prefer habitat corridors for movement and tend to make these movements at night whereas bobcats make these movements less often than coyotes (Tigas et al., 2002).

2.6.2 Ecological role. The ecological role of urban carnivores ties into their predator-prey relationship with other animals. As top predators in most urban systems, urban carnivores have the potential to profoundly affect their environment. They also affect the environment in unsuspecting ways as reflected by the study, *River Channel Dynamics Following Extirpation of Wolves in Northwestern Yellowstone National Park, USA*, coupled with their reintroduction that has recently gained recognition on social media sites (Beschta & Ripple, 2006; "Wolf Reintroduction Changes Ecosystem," 2011). Research suggest that both coyotes and bobcats may serve as a biocontrol for limiting certain nuisance species to residential landscapes such as deer, geese, rats, and rabbits. The presences of urban carnivores have been shown to increase the presence of other species, such as songbirds (Gehrt et al., 2010).

2.6.3 Threat to humans and pets. Contrary to popular perception, urban carnivores pose a low safety risk to humans. Coyotes are more likely to pose a threat to humans and pets than bobcats. Bobcats have not been shown to be a threat to human safety as they tend to avoid humans that get too close. Most reports of threatening behavior are based on human habituation where humans have begun offering food to the animal in question. Typically, both coyotes and bobcats rely on nonhuman food items, and most coyotes in urban areas show no tendency to behave aggressively toward people. Contrary to popular belief, these animals rarely scavenge residential trash receptacles. Coyote threat to domestic cats is the main cause of human-coyote conflict. However, studies on a diet, over time, show domestic pets in diet content is very low (Gehrt et al., 2010).

2.6.4 Coexistence programs and wildlife acceptance capacity. As the number of urban carnivore sightings increases in the DFW area, municipalities and concerned organizations provide educational programs for their communities ("Welcome to Bobcat City U.S.A.," 2017). The City of Dallas, Urban Biologist, Brett Johnson, gives presentations several times a year as does Bonnie Bradshaw with 911Wildlife. This education increases wildlife acceptance capacity, the maximum wildlife population level

(and associated impacts) that community groups are willing to tolerate (Decker & Purdy, 1988). Several variables influence wildlife acceptance capacity including risk perception, the severity of wildlife impacts, personal values, and beliefs. A review of 13 attitude surveys demonstrates that increased carnivore acceptance takes place over time and supports previous studies that acceptance levels increase with time as people and carnivores coexist in the same area (Gehrt et al., 2010, p.29).

Gehrt reports that tolerance levels coincide with impact dependency where a 'need' is affected by human-wildlife interactions as shown in the adapted Maslow's hierarchy of needs and examples of wildlife impacts that may affect each need level (Figure 16).

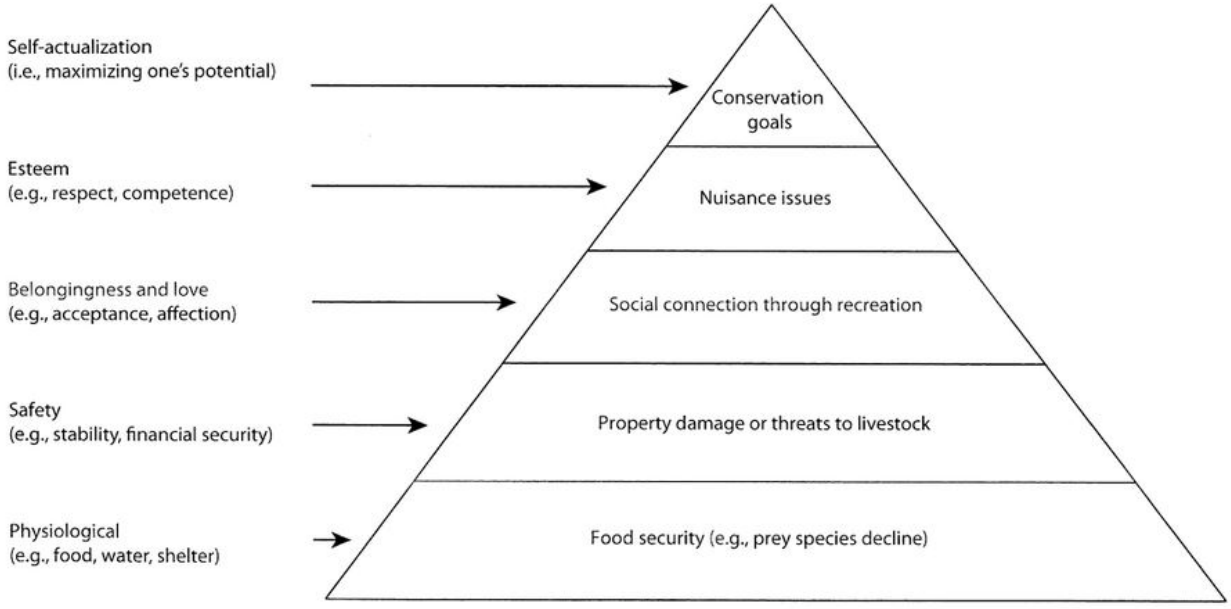


Figure 16, Maslow's hierarchy of needs and examples of wildlife impacts that may affect them *A*dapted (Decker et al., 2006, Gehrt et al., 2010, pg. 27).

2.6.5 Consequences of Co-tolerance. Causes and consequences of co-tolerance are linked to human-carnivore interactions where people encourage a desired response from carnivores which encourages habitation. Interactions between humans and carnivores are increased by food conditioning and habituation. Food conditioning facilitates persistence and leads to increased interactions. Habituation is the wanting of a particular response (Gehrt et al., 2010, p.32). The consequences of co-tolerance in this manner are perceived as either positive or negative. Negative perceptions lead to increased fear.

2.6.6 Conservation. Both coyotes and bobcats are highly adaptable. They are the most successful urban carnivores in North America. Bobcats have minimal negative interactions with people and therefore pose less of concern for management than coyotes. Most studies attribute higher rates of mortality to human activities, such as vehicle and the application of rodenticides (Gehrt et al., 2010, p138). Also, bobcats tend to have a special allure in many people's imagination. Conservation efforts should be based on reducing human-associated mortality and preserving sufficient amounts of suitable habitat. These would ideally be relatively large land parcels that maintain connectivity between other preserved or restored patches (Gehrt et al., 2010, p138). In addition, Gehrt states, " their presence may also benefit conservations efforts more generally."

2.6.7 Wildlife-human interaction around the world. "Animals that live in the city are simply not like animals that live in the wildernesses…they are more urban" reports Kriss (2017) in his recent article, *Why the Planet Earth II Episode on Cities is so Startling. "*The show gives a glimpse of a strange future where the natural world is no longer 'out there' divided from our own lives." The BBC documentary portrays several species that have mastered urban living sometimes reflecting relationships that have evolved over many generations and others much more recently. For example, the greatest concentration of wild leopards is now in Mumbai, India, where rather than pets; they primarily prey on the overabundance of domestic pigs within the city. In Jodhpur, India, langur monkeys fight for territorial rights over the Hindu temple grounds where they are associated with the god named Lord Hanuman and fed lavishly. Research suggest the urban langur populations were protected against large-scale die-off related to a period of drought conditions, 1999-2001 (Waite at el, 2007). Another startling example of coexistence was shown to reveal a 400-year old Ethiopian tradition in which the ancient meat markets leave the remaining bone refuge too dense to dispose of elsewhere in the streets for wild hyenas. The clans of near 60 hyenas battle for territorial rights to enter the market where they devour the butchers' waste. The NY Times reports the butcher tradition started in the 1960's, but residents have been feeding hyenas garbage for generations to keep them from eating people (Linthicum, 2010).

Perceptions of wildlife interactions in the preceding examples are a completely different manner in approaching animal relationships with humanity within our cities. Fear and intolerance drive much of the response to urban carnivores in the U.S. (Gehrt et al., 2010). Take for instance the fact that in 2016,

the USDA wildlife services killed/euthanized a total of 8898 coyotes and 848 bobcats as reported on their Program Data Report G ("The toll taken by Wildlife Services (USDA)," n.d., "USDA-APHIS," n.d.). Much of those eradicated were due to agricultural reasons. However, many municipalities choose to euthanize urban carnivores rather than teach coexistence.

Kriss writes [and research supports] that urban wildlife is smarter than their cousins, have more offspring, spend more time at play, and evolve faster. He proposes an interesting idea,

> "there are fewer animals living in the wild because every day there's less wild for them to live in. We're killing them, extravagantly and catastrophically, burning up whole species in a geological instant, destroying what has existed for millions of years and will never exist again. Of those undomesticated animals that survive, more and more will—like us—live in cities. And all those factors that make urban wildlife different can only intensify. Cities are incubation chambers for particular kinds of behavior. A buried, tentative conclusion: if animal sentience develops, it will do so here [in cities.]"

Kriss thoughts may not be that far-fetched as Jaynes' (2000) proposes theory suggesting human consciousness did not emerge until the Bronze Age (Kriss, 2017). If this is true, it may be possible to nurture human-carnivore relationships in an entirely different way (Chapter 5, Further Research).

2.7 Chapter Summary

The literature clearly demonstrates the need for biodiversity conservation and conservation subdivisions as a possible means to provide much-needed relief from the assault on natural wildlife habitat. Alternatives to rampant land development exist, and green infrastructure is becoming more widely accepted. Builders are beginning to consider conservation subdivisions as an alternative to conventional development. Conservation subdivisions are by far more prevalent in the northeastern and northwestern parts of the United States. However, they are beginning to appear in Texas in regions that focus on ecological continuity and conservation. Conservation subdivisions are not without difficulties. The learning curve must take into account the complexity of entire ecosystems and requires planning at regional scales to be effective. All phases of development are important. Long-term maintenance and planning are particularly critical where wildlife habitat conservation is concerned. In society, where studies show conservation and biodiversity to be imperative, conservation subdivisions offer a viable solution within our reach.

This study combines the focus of conservation subdivisions and habitat viability for urban carnivores found in the North Central Texas suburbs. Even though they are highly adaptable animals, they are more visible in our urban framework than they have ever been in the past. The fact that our urban communities' wildlife acceptance levels are being tested in reference to urban carnivores situates them in a more publicized position that we may be able to take advantage of as design professionals. The fact that urban carnivores prefer particular landscapes in the form of natural habitat and connecting corridors may benefit conservation efforts along those lines and affect conservation efforts on the whole.

Chapter 3: Research Methods

3.1 Introduction

This research uses the qualitative methodology of in-depth phone interviews to understand participants' views on the topic. The five conservation subdivisions represented in this study are Chimney Rock, High Meadow, Montalcino Estates, The Sanctuary of Flower Mound, TX, and Montgomery Farms of Allen, TX. The selection of developments was due to their location in North Texas near where the researcher resides (Figures 17-19). Conservation Subdivisions in North Texas are relatively uncommon. However, two other subdivisions in North Texas were identified (The Woodson Place, Rains County and Los Establos, Rockwall County). The study acknowledges their existence in North Texas rural areas outside the study area. No other conservation subdivisions were identified.

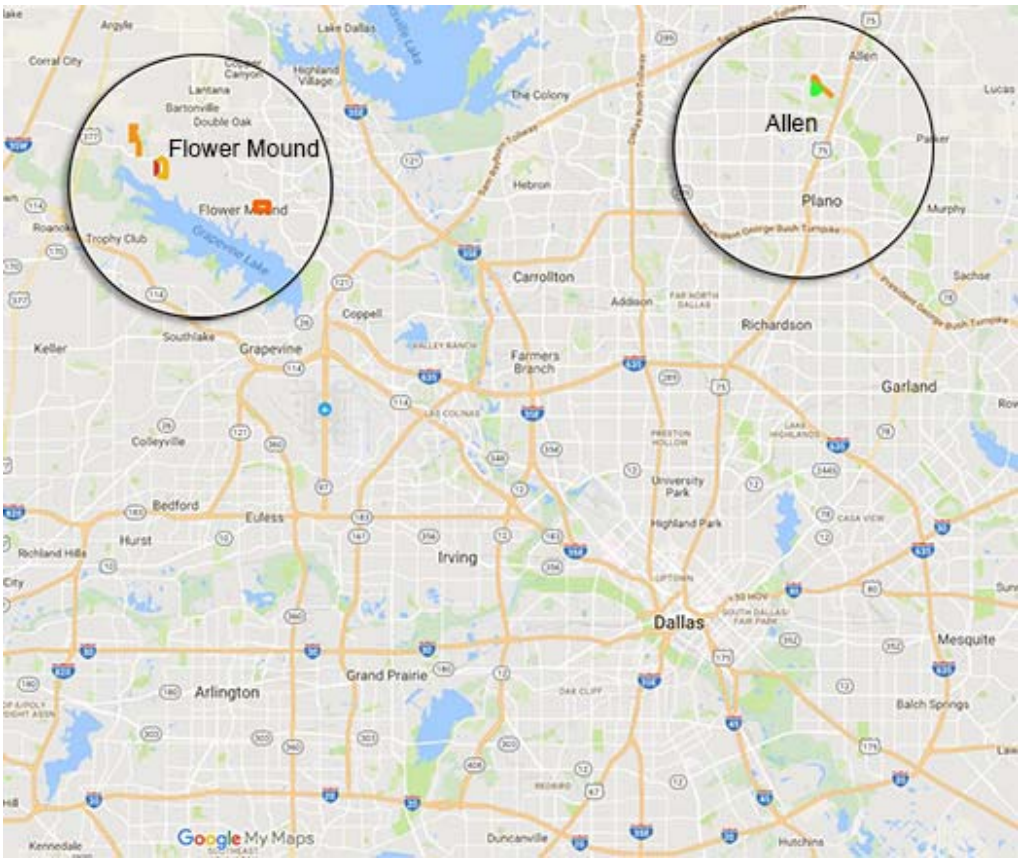


Figure 17. Study area map
Conservation Subdivisions of Flower Mound and Allen (Google Maps).

Figure 18. Study area map, Flower Mound CS boundaries (CCF, Google Maps).

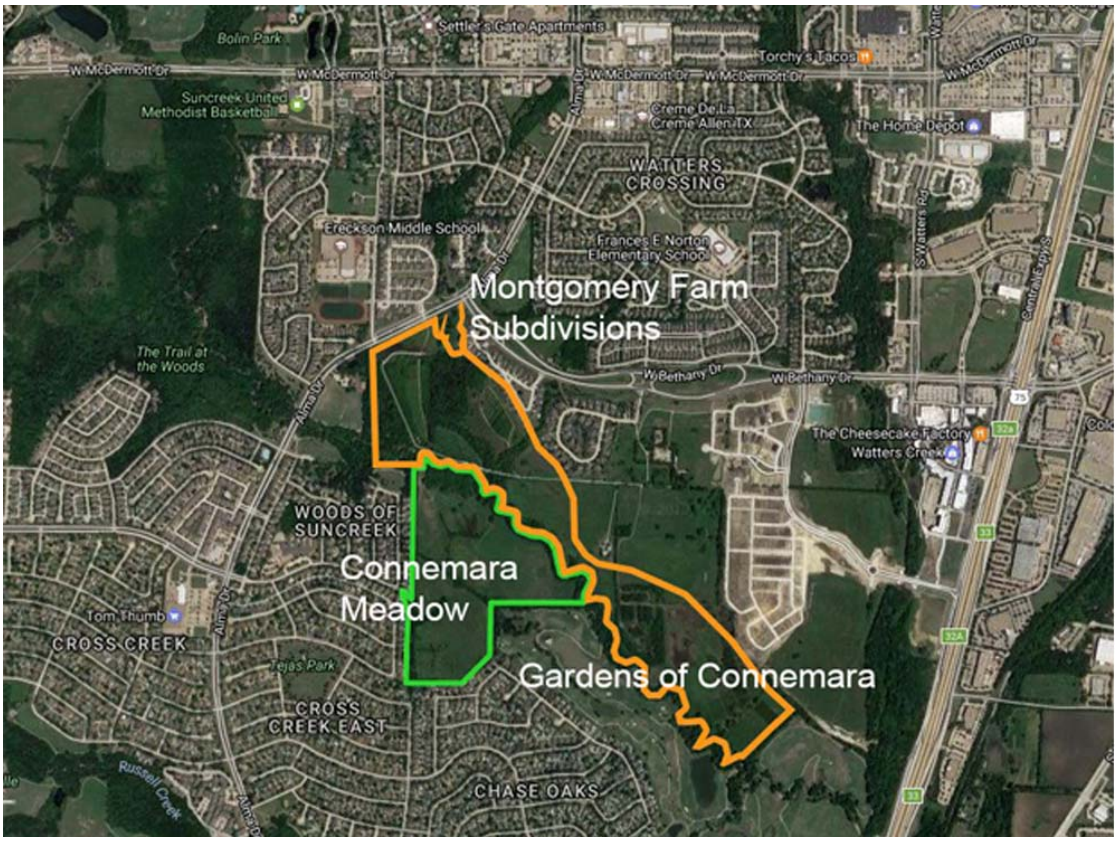


Figure 19. Study area map, Allen CS boundaries (CCF, Google Maps).

3.2 Research Design

The research design used for this study was a technique formulated by Taylor et al. (2015). It emphasizes five specific categories addressed by this study. The categories include:

- Technique,
- Access strategy to gain participants,
- Anticipated number of participants,
- Data and recording procedures, and
- Analysis.

It also used the multi-method approach in which different research techniques are applied yielding a different view of the data (Sommer, 2001).

3.2.1 Technique. The primary technique used for the research was qualitative in-depth phone interviews, designed to gather descriptive data from verbal responses (Sommer, 2001). The interviews conducted for this research consisted of informal conversations. Phone interviews were conducted via Sprint WebCapTel service, a web-based captioning service used for persons with hearing loss. It allows voice users and WebCapTel users with hearing loss to converse with an intermediary captioning provider (the CapTel operator relays the voice users' spoken word to a voice activated recognition software for real-time captioning that appears on a computer connected to the call). The participants in the study were briefed on researcher need for the use of the CapTel service and were allowed to choose when they preferred to conduct the interview. Participants provided consent for follow-up questions as deemed necessary by the researcher. All CapTel interviews proceeded without technical difficulties except two that were rescheduled due to bad connections and one that was disconnected. All proceeded normally after establishing a fresh connection.

The secondary and tertiary techniques used for this research were researcher field observation and review of secondary data per the literature review in Chapter 2. Each subdivision was observed by the researcher and field notes recorded. Secondary data discovered regarding builders and development, real estate, conservancy, governance, and so on was reviewed and analyzed in Chapter 4.

3.2.2 Access strategy. Participant selection was contingent on locating professionals that worked in proximity to the chosen conservation subdivisions in any of the three phases of development: design, construction, or post-construction. In addition, participants were chosen for their professional

experience linked to either conservation subdivisions in general, in North Texas, or wildlife habitat in North Texas.

3.2.3 Participants. Participants were chosen for their professional knowledge or exposure related to the design, development, and maintenance of the conservation subdivisions in North Central Texas. The population makes up 14 interview respondents consisting of three registered LAs, one developer, two urban planners, two land trust executives, one conservation manager, three homeowner's association presidents, and two urban biologists. Several of the interview subjects had past professional history in one or more of the other professions interviewed. For instance, one of the HOA presidents was involved in planning and development, one of the land trust executives was also an urban biologist, and one of the registered LAs was involved in the creation of SITES. All participants have agreed to be named in the study and have been included in the appendices.

3.2.4 Data collecting and strategy. Data was captured from the interviews through the Sprint CapTel relay service. An unedited interview transcript of the on-line, captioned conversation was digitally saved and consulted for analysis. Field data in Section 3.3.7 was collected by responding to a field observation survey prepared before visiting the location. Secondary data was captured by way of literature review, including information provided from interviewees.

3.2.5 Data analysis and procedures. Before analyzing the data, it was first coded through a three-step process adapted from Saldana (2015). Initially, a code was applied to each line of dialogue offered by the interviewee. The goal was "to remain open to all possible theoretical directions indicated in readings of the data." Coding was accomplished using the online subscription software Dedoose.com which allows for "for analyzing qualitative and mixed methods research with text, photos, audio, videos, and spreadsheet data" ("Home | Dedoose," n.d.). Domain analysis was then completed described by Atkinson & Haj (1996). Finally, grounded theory was used to answer the applied questions in this research study (Strauss & Corbin, 1998).

During the coding process, excerpts from the interviews were sorted into the categories of:

- Descriptive topics,
- Structures,
- Magnitudes,
- Processes,
- Themes,
- Attributes,
- Values and emotions,
- Participant quotes expressing intensity, and
- Comparisons

Codes and their related functions and examples are summarized in Table 4.

CODING METHODS	CODES APPLIED	FUNCTIONS	EXAMPLES
Initial coding	241	The goal is "to remain open to all possible theoretical directions indicated readings of the data."	Line by Line – assigning a code
CODING METHODS BY FUNCTIONS			
Descriptions or Topics	431	Nouns, assigning topics, Social environments	Trees, green space, viewsheds, HOAs (groups)
Evaluation	165	Judgements	What should be done?
Structural	184	Methods, policy, plans	Educational set up, post-construction
Magnitude	265	Intensity, frequency, direction, presence	Strong-mod-no opinion, positive or negative
Process	51	Observable activity, conceptual action (also called action coding)	“ing” words
Theming	159	Describe or capture the meaning (phrases)	What conservation means?
Attribute	230	Features of the site, participants, materials	Age, gender, educational level, profession
Emotion and Values	164	Feelings, reactions, excitement Values, Altitudes, Beliefs	Failure, fear, overwhelmed, frustrated, affinity V-education B-Existence of discrimination A-Sense of uncertainty
Quotes	54	Using own words	Explanations or narratives
Verses	62	This vs. that	Plan vs. Reality, HOA vs. Land Trust, model 1 vs. model 2
CODING METHODS GROUNDING THEORY		Links findings to literature review	
Elaborate		Top-down approach that supports other studies	It builds on previous research and investigations
Focused		Frequency for most salient categories	For Domain Analysis and developing categories
Pattern		What is going on here? What is the phenomenon?	Social networks, processes, themes, rules, causes, explanations - theories
Theoretical		Umbrella themes	

Table 4. Coding Methods, Researcher notes, adapted (Saldana, 2015)

Initial coding reflected on the initial data set with the goal "to remain open to all possible theoretical directions indicated by readings of the data," (Saldana, 2013). A code was assigned line-by-line/s to the participants' interview responses which resulted in 241 codes applied to 530 excerpts (a short extract from the text) in 1128 instances. Therefore, various codes were applied 1128 times throughout all the interviews.

Next, codes were categorized by function (see Theming Method, Table 4, p.60) and concept mapped (Figure 20, below), facilitated by the program Cmaps (http://cmap.ihmc.us/, "Home," n.d.).

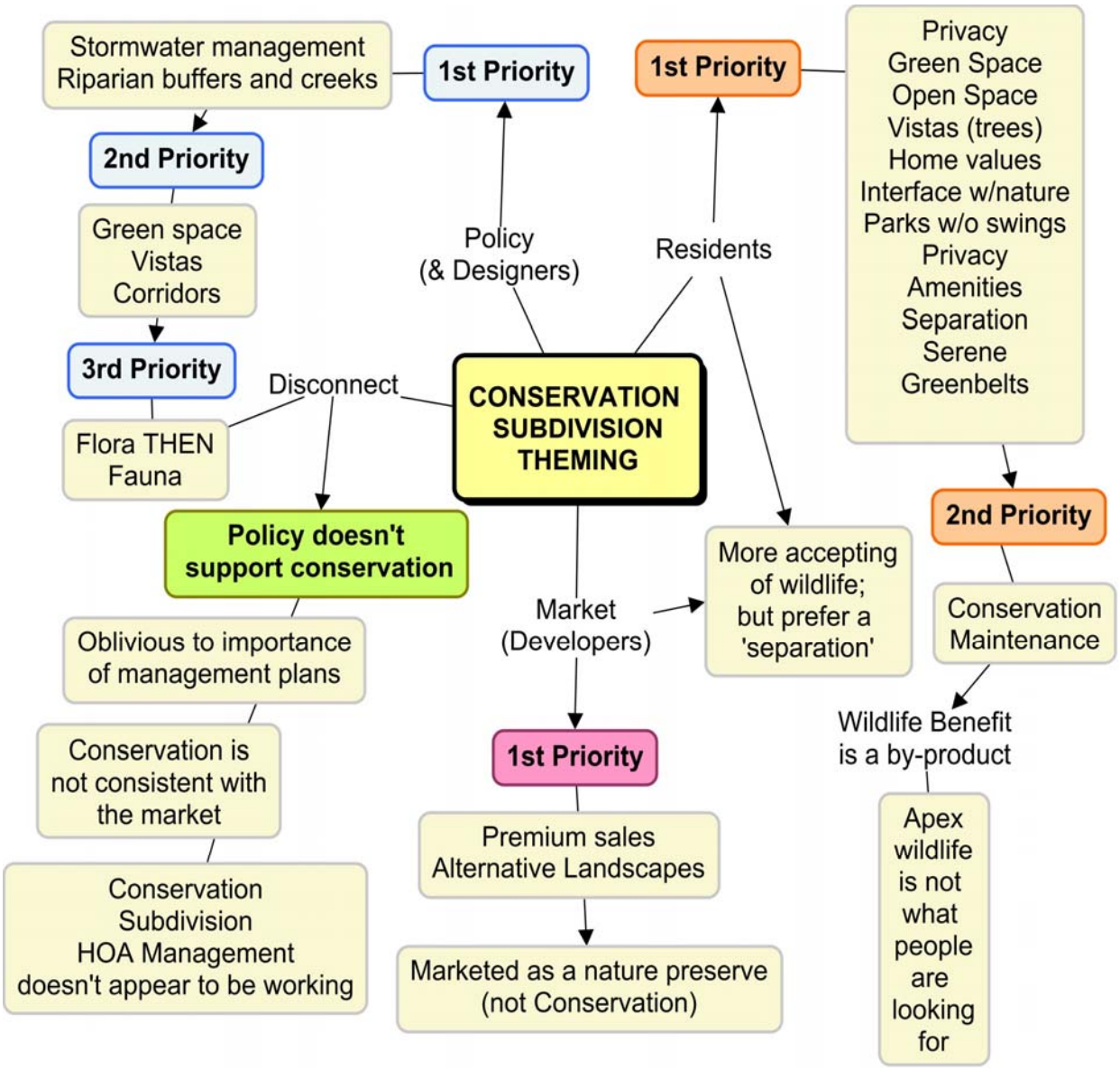


Figure 20. Concept Map for CS Theming

Function methods were chosen to aid the search for pertinent information. Attribute coding was used to set the foundation for understanding the content of the interview responses. Descriptive-topic coding was used to focus on design elements and related information regarding the needs of urban carnivores in suburban settings. Values, attributes, and beliefs methods were used to gauge emotional perceptions and combined due to their interrelated nature. Evaluation coding noted the judgments made by the informants. In vivo coding used quotes from the interviewees own words and was used to get a feel for the passion in the responses. It aids in understanding the magnitude and intensity of the participants' values and beliefs about the subject. Magnitude coding explored the intensity, presence, and position either for or against, positive or negative regarding issues surrounding urban carnivores, conservation subdivisions, and marketing for those subdivisions with carnivore images. Thoughts on financial market values were also coded under this method. Process coding captured references to the action surrounding the subject. Structure coding aided in determining the models employed in the conservation subdivisions discussed and the underlying policy and mentality in Texas that affects conservation development. Theme coding captured the themes concerning what prospective buyers look for or are attracted to in North Central Texas suburbs and where wildlife fits into this picture. Finally, versus coding compared "this versus that" about plans versus the reality primarily focused on the discrepancy between plans and the reality of CS design and function.

Once coding was completed, domains were identified and related to one another. The results were further examined in the final step to ground the theory to come to an understanding of the phenomenon of CS as habitat for urban carnivores in North Central Texas suburbs and the nature of participants' realities concerning the topic.

3.2.6 Interviews. Interviews were scheduled so that as many as possible were to transpire within the time-frame of the study. This process permits sufficient interviews so that themes or patterns emerge from the participants' responses. Recurring themes and patterns, then cue the researcher that the process (either in an interview or as a whole) is complete (Sommer, 2001; Taylor, Bogdan, & DeVault, 2015).

A pre-interview document (Figure 21) was sent to participants via E-mail for reference to operational definitions used as a basis for interview questions. It also included photos for reference for question fourteen.

For the purposes of this interview the following operational definitions will be used:

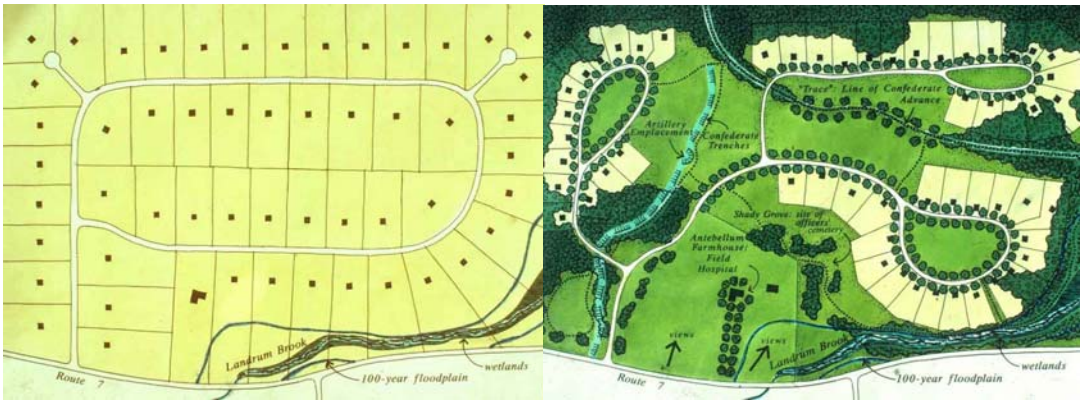


FIGURE 1., Conventional Subdivision (above left with 2-acre house lots) vs. Conservation Subdivision (above right with just under 3/4 of an acre, 30,000 sq. ft., house lots) with the **SAME number of home sites (55)** on a 130-acre site. The conservation subdivision preserves almost two-thirds of the site, 62%, 81 acres. (Landchoices.org)

1) **Conservation subdivisions are defined as having the following characteristics:**
   Water Quality Preserved: The design greatly reduces or eliminates stormwater run-off due to large tracts of natural areas that absorb and filter water. Narrower, shorter streets reduce impervious areas while swales instead of curb and gutters absorb stormwater instead of polluting lakes, rivers, and streams.
   Natural Areas and Wildlife Preserved: Conservation subdivisions preserve 50% - 70% or more of the buildable land, plus unbuildable wetlands, steep slopes, and floodplains.
   Percentage of Land Preserved: In urban, sewered, high-density areas zoned at 2-3-4 units per acre, preserving 40% open space, in addition to the unbuildable wetlands, floodplains, and steep slopes, is the norm. In rural, suburban edge areas at densities of 5 and 10 acres per dwelling, easily 70% or more of the land can be preserved.
   Same Number of Homes: The same number of homes can be built as allowed in conventional "cookie-cutter" subdivisions (Figure 1).
   Source: http://www.landchoices.org/naturalneighborhoodphotos.htm Adapted from Randall Arendt, (Arendt, 2004, 2010; Arendt & Brabec, 1994; Arendt & Harper, 1996).

2) **Urban Carnivores** For the purpose of this study, the interview questions refer to the most common top land mammalian urban carnivores found in North Central Texas prairies and cross timbers: bobcats, coyotes, and foxes. These carnivores are considered apex or near apex predators found at or near the top of the food web.

3) **Patch** is defined as a relatively homogeneous area that differs from its surroundings. Patches have a definite shape and spatial configuration and can be described compositionally by internal variables such as the number of trees, the number of tree species, the height of trees, or other similar measurements. For this study, patches refer to the areas of land conserved in conservation subdivisions, the urban land that makes up creek corridors, urban land that makes up area parks, or land that make up the area greenways.

4) **Greenway** is a linear strip of undeveloped land patch near or within an urban area, set aside for recreational use or environmental protection. It may consist of a trail and is sometimes referred to a wildlife corridor. They are a result of various practices which may include railways, creek corridors, or be found within urban park systems.

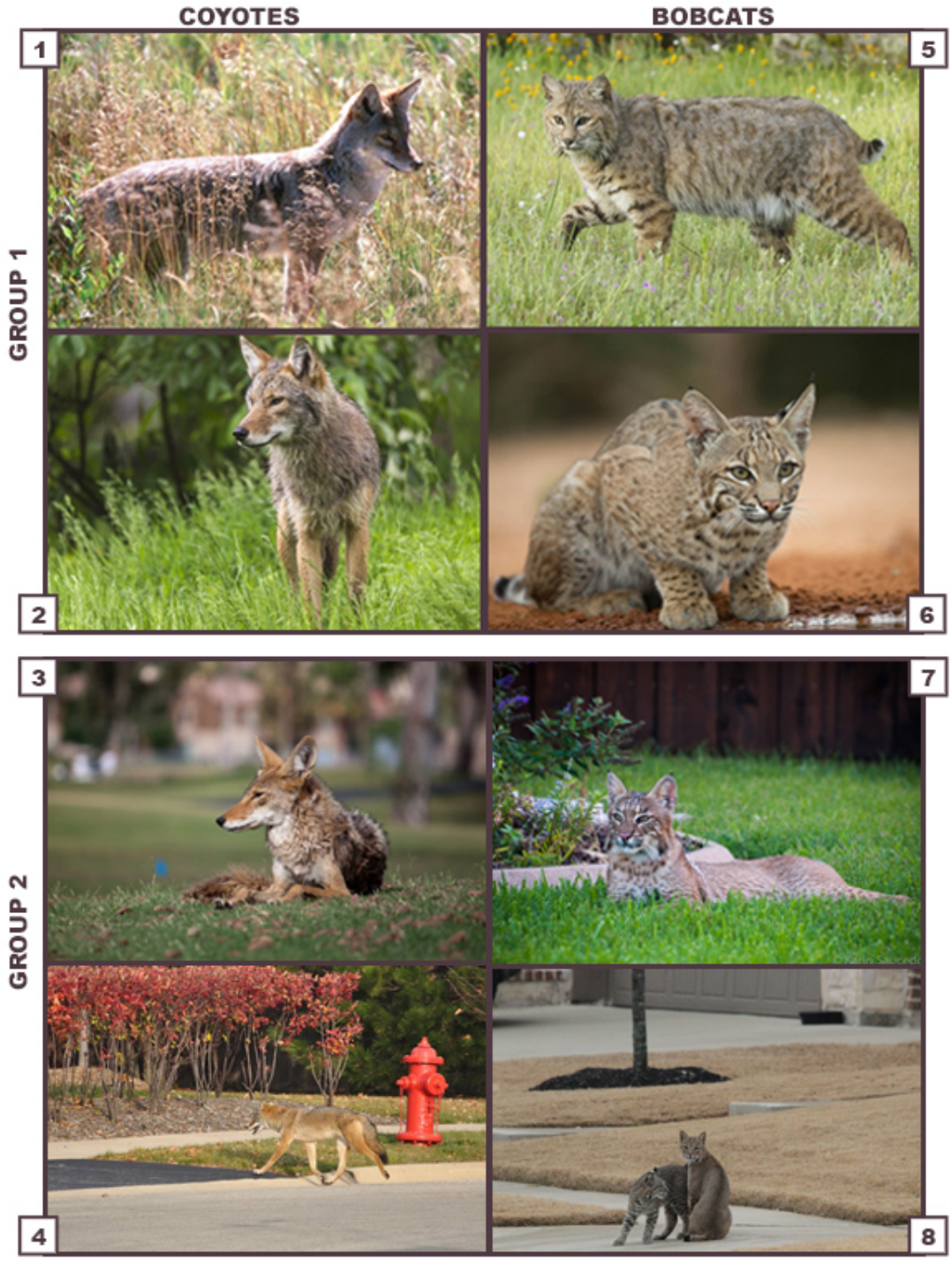


Figure 21. Pre-interview document

After confirmation of receipt and review of the pre-interview document, interview questions were as followed:

Conservation Subdivisions:

1. What is your experience in relation to conservation subdivisions?

2. What conservation subdivisions are you aware of in North Central Texas?

3. How would you compare or describe them to the operational definition provided?

4. How are they received in North Central Texas?

a. What could be done better?
b. What are specific barriers in North Central Texas? (policy)?

Urban Carnivores in North Central Texas Suburbs:

5. What knowledge do you have of urban carnivores in the North Central Texas suburbs?

a. How do you usually gain your knowledge concerning urban carnivores?

6. What, if any, is the value in having urban carnivores in suburban areas?

7. Do you support or oppose their presence?

a. Why?

8. What city or municipal policies are you aware of concerning urban carnivores in North Central Texas suburbs?

a. Do you favor or oppose those policies?
b. Why?

Habitat for Urban Carnivores:

9. What is necessary for good urban habitat for urban carnivores in North Central Texas suburbs?

a. What are good urban plant characteristics?
b. What are good urban patch characteristics?
c. How important are patches that make up linear urban greenways?
d. To what extent are larger urban patches important vs. urban linear greenways?
e. What do you think about encouraging appropriate urban water sources or wildlife?
f. What are your thoughts on habitat for raising their young?

10. To what extent does quality habitat affect the population density of urban carnivores in North Central Texas suburbs?

Conservation Subdivisions as Habitat for Urban Carnivores:

11. How do conservation subdivisions affect the presence of urban carnivores compared to traditional subdivisions?

12. What do you think about the idea of conservation subdivisions being used as habitat for urban carnivores?

13. How do you think North Central Texas development and planning stakeholders would accept incorporating carnivore habitat into the overall design of conservation subdivisions?

a. Who are the decision makers?
b. What would it take for this to be successful?
c. What would be the barriers to success?

14. Would any of these images (see pre-interview document) be useful in marketing for a conservation subdivision?

a. Why?
b. Would one of any of these photos be preferred over the other?

15. What do you think home buyers are interested in when they chose to live in a conservation subdivision?

a. Do you think they are more tolerant of, or more appreciative of, urban carnivores?
b. Why do you think that is?

16. What safety issues may arise?

a. How could they be solvable by design?

17. What are your thoughts on domestic pet conflicts with urban carnivores?

18. From a public perception standpoint, how much, if any, should consideration for patch habitat for urban carnivores be given in the design process of conservation subdivisions?

3.2.7 Field data. A conservation subdivision visual inspection of habitat for urban carnivores was created based on information gleaned from the literature review concerning wildlife habitat planning in conservation subdivisions (Arendt & Brabec, 1994; D. M. Hostetler, 2012; M. Hostetler & Drake, 2009). Additionally, the sustainable sites initiative and integrated design strategies for small-scale sites and residential landscapes were consulted (Home | SITES," n.d.; Venhaus, 2012) as well as references uncovered through the American Society of Landscape Architects resource pages (Green, 2010b; "Protecting and Restoring Habitat in Urban Ecosystems," n.d.) and specific habitat needs to be required for urban carnivores (Gehrt, Riley, & Cypher, 2010). Table 5, field data checklist, includes native landscaping, invasives, wildscapes vs. lawns, open space observations, edge & corridor observations, surrounding areas adjacent to subdivisions as well as bobcat and coyote habitat preferences (Gehrt, Anchor, & White, 2009; Gehrt et al., 2010; Riley et al., 2003; Tigas, Van Vuren, & Sauvajot, 2002).

FIELD DATA CHECKLIST

Conservation Subdivision Visual Inspection of Habitat for Carnivores
Hydrology (fresh water sources)
Biorention or Rain Gardens
Run-off is gray to green
Ecosystem Model (invasive control)
Maintenance plan in place per interviews?
Sustainment of Defining Systems (provides food and cover)
Key Plants used (look for main prairie plants and grasses)
Native landscaping
Invasive landscaping
Diverse use of plant materials
Wildscapes are present
Lawns
Plantings are vertically layered
Open Space Observations
Corridors
Surrounding areas adjacent to subdivision
Natural Cover, interior habitat preferred
Understory for Carnivores
(per John Davis interview, Wildlife Diversity Specialist, TPWD)

Table 5. Field date checklist

3.2.8 Scoring. Scoring for the field data was completed based on researcher perceptions and expressed using a five-point Likert scale for each section, in which 0 indicated no evidence noted and five indicated a perfect perception of the topic it referenced.

3.3 Research Limitations

The main limitation of this study is the small number of conservation subdivisions in North Texas as of 2017. Conservation subdivisions have only recently been considered as a viable alternative to traditional development in North Texas. Additionally, limited access to conservation development affects the availability of professionals in North Texas design fields that have experience working with those developments in the targeted ecoregions. Furthermore, the researcher's use of an internet captioning

service may have affected the outcome of the interviews. However, after explanation of the process, interviewees seemed to be comfortable with the technology.

3.4 Chapter Summary

For the purpose of this study, interview questions presented to participants were intended to provide LAs and related design professionals with professional and resident perceptions regarding the success of wildlife habitat for urban carnivores in conservation subdivisions. The study was location specific to the Blackland Prairie and Cross Timers ecoregions in North Texas. This chapter outlined the five-step process used for qualitative research as described by (Taylor et al., 2015). A multi-method approach to collecting data was achieved through three different methods of data collection. The findings were organized according to themes that emerged from all three methods. They were further examined in parallel with the literature review and presented in Chapter 5 alongside researcher suggestions for further research. Limitations were acknowledged and presented in the summary.

Chapter 4: Findings and Analysis

4.1 Introduction

This chapter describes the analysis of 14 in-depth telephone interviews as well as collection of field data from three conservation subdivision sites. Respondent background was first presented followed by the domain analysis. Research findings are organized according to themes that surfaced during the analysis from the four main topic areas covered in the interviews. This organization format allowed for overall themes to emerge from each of the four sets of interview questions. Domain analysis was followed using the four-step process outlined by Atkinson & Haj (1996):

1. Identify the domains,
2. Construct a taxonomy of sub-categories,
3. Specify the components, and
4. Relate the domains.

The intent of the first set of questions was to provide background information from respondents concerning their experiences related to conservation subdivision development. The second set of interview questions targeted participants' knowledge and perceptions of urban carnivores in North Central Texas. The third set of questions focused on informants' thoughts about urban habitat for urban carnivores. The field data collected added researcher perceptions concerning the conservation subdivisions as habitat. The final section of questions specifically targeted the interviewees' thoughts about the viability of conservation subdivisions as habitat for urban carnivores, including their opinions on what type of urban carnivore graphical images might potentially be useful in marketing for a conservation subdivision in the study area.

4.2 Background

During initial recruitment for the interview process, a total of 14 informants from various backgrounds professions related to land development and conservation of natural resources agreed to participate in the study agreed to participate in the study. Participants are represented in Figure 22 and summarized in Table 6. Several of the participants have experience in multiple disciplines that provided unique insight into this research. At least two of the participants have written books in their area of expertise. All participants are considered experts in their field by the researcher and have consented to

be named in the study. Two of the LAs are principals, and one is a lead LA working directly with planning and design of CS in the study area. One LA has contributed to the SITES benchmarks, its AP accreditation exam, and the Landscape for Life program. Both urban planners have direct experience with CS in the study area. All urban biologists have TPWD field experience and one has direct experience with CS in the study area. One land trust executive is on the board of The Connemara Conservancy that holds all the land easements in the study area. The other land trust executive is also an urban biologist. All HOA board members are either current or past president board members.

Figure 22. Respondents

1-Bob Mione	Connemara Meadow Restoration Manager; Field experience – 8 years
2-Heather Venhaus	RLA, Principal Restorative Ecological Design; Field experience - 18 years
3-Stan Cowan	RLA, Managing Principal Mesa; Field experience - 30 years
4-Robert Stewart	RLA, G&A Consultants (Conservation Subdivisions); Field experience – 37 years
5-Ogden "Bo" Bass	Urban Planner, City of Allen, Planning Director; Field experience – 30 years
6-Randall Arendt	Urban Planner, Greener Prospects; Field experience – 42 years
7-Brett Johnson	Urban Biologist, City of Dallas, Past TPWD; Field experience – 17 years
8-John Davis	Urban Biologist, TPWD Wildlife Diversity Director; Field experience – 25 years
9-Mark Steinbach	Texas Land Trust, Executive Director, Urban Biologist; Field experience - 13 years
10-Scott White	Connemara Conservancy, Past President; Field experience – 20 years
11-Philip Williams	Developer, Emerson Partners, Montgomery Farm; Field experience – 29 years
12-Greg Alexander	Bethany Mews HOA, Montgomery Farm, Allen; Resident – 3 years
13-Robert Clement	Chimney Rock HOA, Flower Mound; Resident – 11 years
14-Scott Shea	The Sanctuary HOA, Flower Mound; Resident – 5 years

Table 6. Respondents

4.3 Domain Analysis of Interview Data

The first step required the identification of primary domains from the interview discourse. Once the primary domains were established, a taxonomy of sub-categories was established. Specifying components follows. This step is completed by presenting actual interview phrases to support the first two steps. The last stage identified relationships between subcategories and relating the findings back to the research questions and primary domains (Atkinson & Haj, 1996).

4.3.1 Identifying the domains. The interview data indexed from the codes and concept maps allowed for a preliminary list of topics arising from the study interview questions (Table 7). Domains identified from initial topics included a set of broad domains that included:

1. Background experience with nature/wildlife,
2. Preferences for nature or wildlife,
3. Structure for success of both CS and habitat, and
4. Knowledge of urban carnivores (Table 8).

Preliminary List of Topics Discussed – Researcher Notes

Tolerance of apex predators:
+Acceptance, separation protection from, landscape destruction, provide ecological services, balance

Adaptability of urban carnivores:
+Generalists, mobility on streets and corridors, fatal to relocate

CS are misunderstood:
+Lack of perspective, +no accountability, market amenity but not really focused on conservation Lack of integrity. Realtors misunderstand as well and misrepresent, long-term failure of conservation

Preferences of CS:
+Green spaces, trees, preserved spaces, + views, base-level creatures, protect water, +privacy

Preferences of urban carnivores:
+Cover, places to hide, away from people, ways to move

Design Elements for urban carnivores:
+safety, native plants, +post-construction, education

Successful CS needs:
+Clear definitions, education, inventory/assessments, post-construction plans

Conservation Easements:
+Not helpful to homeowners, legal restrictions

Feelings about wildlife
+Fear, affinity, +safety

Policy & CS Development:
+Market- driven, finding Balance. Sell at premiums, perceived as “double-green”, plans do not equal reality.

Marketing w/urban carnivores:
+Disincentive, fear, some intrigued by bobcats, natural setting is more acceptable.

+Denotes a subject that was of primary importance in the discussions.

Table 7. Primary list of topics discussed

Preliminary Domains Identifyed – Researcher Notes

Background: values & beliefs
Emotions – Fear, affinity, tolerance (acceptance)

Preferences (values) – Safety, green spaces

Structure – drives success (plans vs. reality) of CS and urban carnivore habitat, implementation, policy, Texas mentality, easements, education, Sub-set: Attributes for habitat, CS, Respondents

Understanding urban carnivores – habitat, adaptability, misunderstood, preferences

Table 8. Domains identified

4.3.2 Constructing a taxonomy of sub-categories. Once the domains were established, a taxonomy of sub-categories was compiled and are presented in Figure 23. During the taxonomic analysis phase, topics most important to the interviewees were revealed. The next steps included identifying the components from the interviews that support the taxonomic analysis and relating the findings to the research questions. Findings are summarized in Section 4.4.

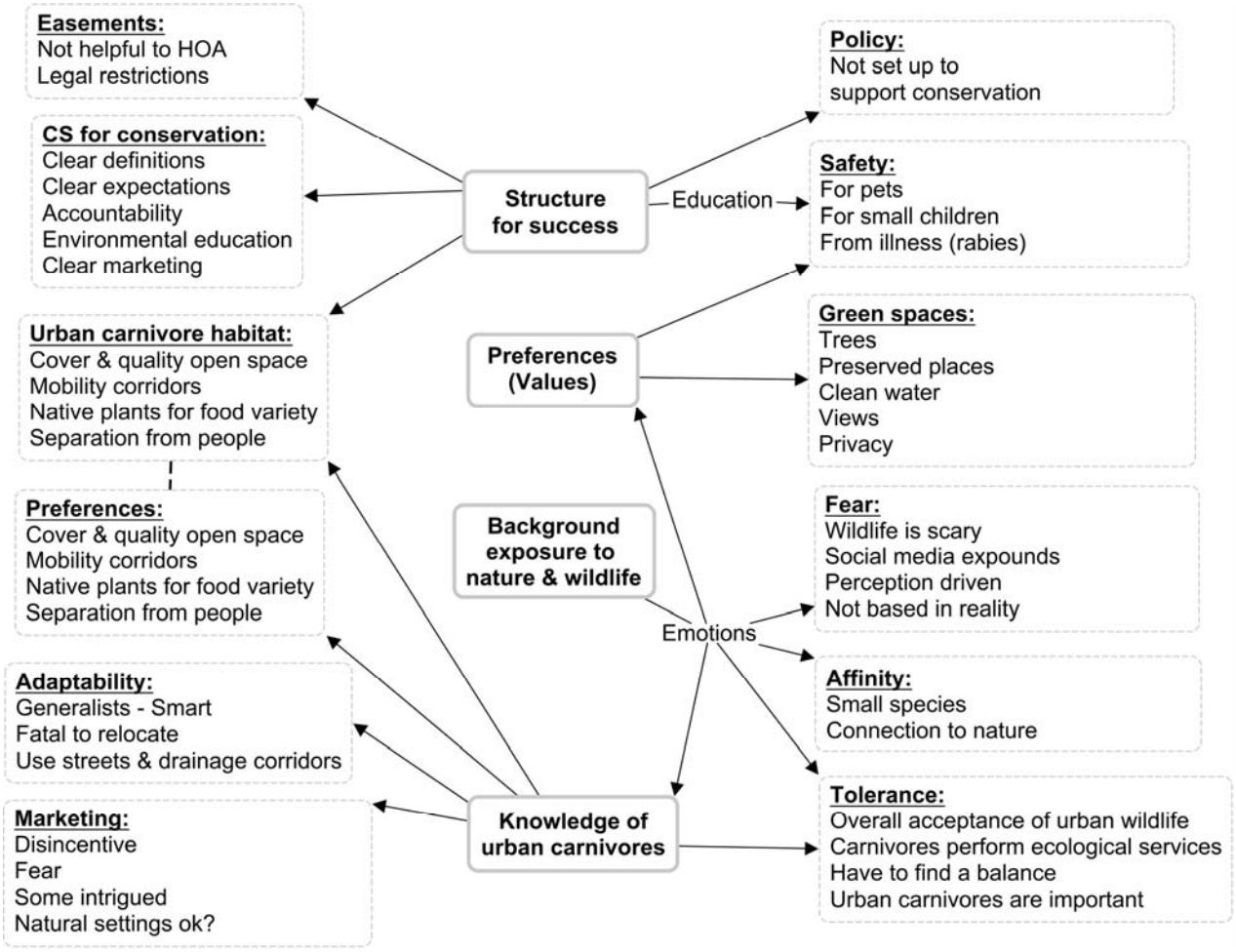


Figure 23. Taxonomic analysis

4.3.3 Field data. Field data consisted of data from area conservation subdivisions. Three interview respondents reside in conservation subdivisions within the study area. They include Chimney Rock and The Sanctuary in Flower Mound and Bethany Mews, Montgomery Farm in Allen. Montgomery Farm is a set of 11 subdivisions. Several other subdivisions within the Montgomery Farm development were observed with particular attention to Bethany Mews which is adjacent to the easement area. Site

visits were performed, and photo evidence was compiled for each visit. Field data was used to respond to the researcher's perception of CS habitat. Each subdivision was rated using a 5-point Likert scale. Accumulated points were then tallied for a total scale rating of the site. Five areas were considered in which 20 points would indicate a perfect score. Urban carnivore habitat was the primary deciding factor for scoring and included sections affecting water, food sources and shelter that wildlife need to survive. Photographs and findings are presented in Section 4.4.1 (Figures 24-26).

4.4 Findings: Specifying Components from the Interviews

Inherent to the interview process was the acquisition of a substantial amount of complex data concerning feelings and attitudes about a particular topic or topics. Field and interview data were considered separately. To address how the data set informed the research questions, they were addressed by specific sections from the interviews. In order to give context to the interview data, field data is presented first.

Characteristics of CS in Allen and Flower Mound tend to vary due to location and policy differences. The Flower Mound CS are situated within a conservation district and exhibit larger lots. The easement property is usually owned by the HOA and has a rural character. Chimney Rock is located 10 minutes west of I35 per researcher drive time. Montgomery Farm is suburban in nature and residences are placed on much smaller lots. The easement property is owned and maintained by the developer. Montgomery Farm is a planned conservation development which consists of 11 subdivisions just west of I75. It is situated next to Watter's Creek, a new urbanist complex.

4.4.1 Field data. Regarding urban carnivore habitat adaptability, all three subdivisions should reflect urban carnivore presence. Due to Chimney Rock's patch characteristics, connectivity, and proximity to Lake Grapevine, it should experience more activity, followed by Montgomery Farm, and finally, The Sanctuary. Field data ranked Chimney Rock highest regarding habitat and connectivity. Chimney Rock is rural in appearance situated on 2-acre lots and backs up to Lake Grapevine. The subdivision was clearly designed for grey-to-green water functionality and has several preserved prairies conserved and maintained areas. The Sanctuary ranked lowest regarding habitat and connectivity. The design lacked specific appearance towards conservation design in general. It does, however, back up to preserved green space. Common areas are maintained as lawns and drainage appeared traditional in

function. Montgomery Farm ranked between the two with more attention placed on native landscaping and key prairie plants. Some rain gardens were noted, as were some grey-to-green design features. Due to the suburban nature of Montgomery Farm, it did not rate as high in connectivity, yet for application within a suburban context design implementation, it rated much higher than The Sanctuary. All subdivision residences ranked low in native landscaping with Montgomery Farm ranking highest. It was noticed that Montgomery Farm also used monocultures, however those consisted of native plants. Table 9 displays the field data rated by the researcher:

Conservation Subdivision Visual Inspection of Habitat for Carnivores	**Chimney Rock**	**The Sanctuary**	**Montgomery Farm**
Hydrology (fresh water sources)	**5**	**0**	**3**
Biorention or Rain Gardens	+	-	+
Run-off is grey to green	+	-	+/-
Ecosystem Model (invasive control)	**4**	**0**	**3**
Maintenance plan in place per interviews?	+	-	+/-
Sustainment of Defining Systems (provides food and cover)	**3**	**1**	**4**
Key Plants used (look for main prairie plants and grasses)	+	-	+
Native landscaping	-	-	+
Invasive landscaping	-	-	-
Diverse use of plant materials	+/-	+/-	+/-
Wildscapes are present	+/-	-	+/-
Lawns	-	-	-
Plantings are vertically layered	-	-	+/-
Open Space Observations	**4**	**2**	**3**
Corridors	+	-	+/-
Surrounding areas adjacent to subdivision	+	+/-	+/-
Natural Cover, interior habitat preferred	+	+/-	+/-
Understory for Carnivores			
(per John Davis interview, Wildlife Diversity Specialist, TPWD)	+	+/-	+/-
+/- indicates researcher's general perception of positive or negative presence	**16**	**3**	**13**

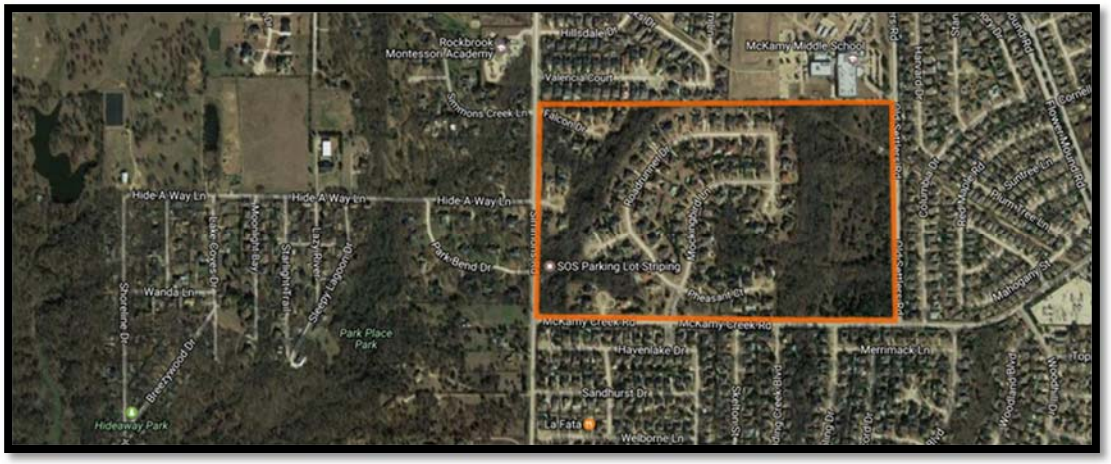
Table 9. Field data, Researcher ratings

Chimney Rock – Score 16:

Chimney Rock was found to have the following features:

- Grey to green, no curbs,
- HOA maintenance, $70k,
- Lawns, Invasives,
- Maintained prairies,
- Connected corridors, connected to other CS and Lake Grapevine USACE land,
- Large amount open space,
- Natural cover, abrupt edges,
- Bioretention, and
- Large 2-acre lots with no direct highway mobility access increases sprawl

Figure 24. Chimney Rock field data map, photos

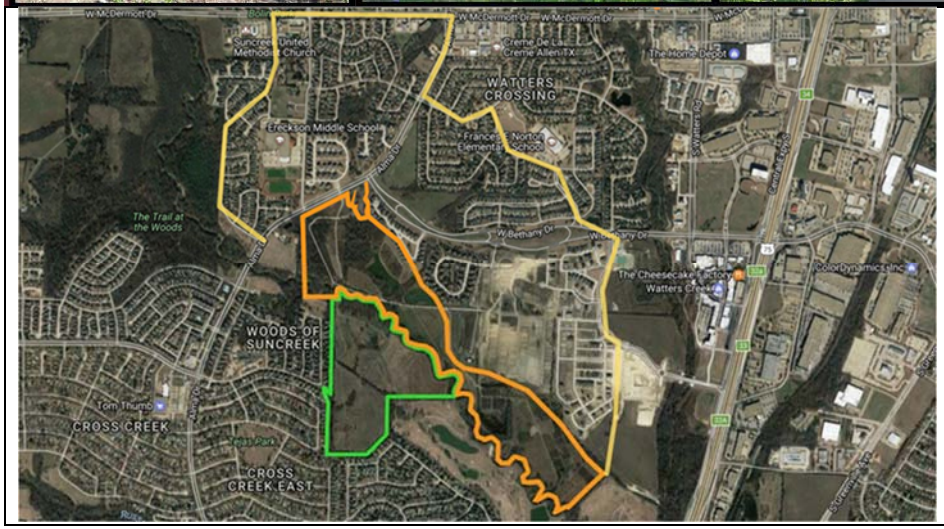


The Sanctuary – Score 3:

The Sanctuary was found to have the following features:

- Completely guttered
- HOA maintenance, $0, states they do not own the easement land. However, Connemara shows they do
- Lawns, Invasives
- Corridors – Some connection
- Mobility is disrupted by heavy trafficked
- roadway blocking parks/lake
- Small area natural cover, abrupt edges
- No bioretention
- More direct access to highways

Figure 25. The Sanctuary Field Data map, photos



Montgomery Farm – Score 13:

Montgomery Farm was found to have the following features:

- Semi-guttered
- Rain gardens
- Native plants in common areas
- HOA maintenance, $0 – builder owns easement land w/maintenance funds from fee transfer
- Lawns, Invasives
- Corridors – connects to city plan
- Adjacent to natural cover, good edges
- Bioretention, but near traffic
- Nice prairie open space but it's in a median – detrimental for wildlife mobility crossing
- Varied home sizes
- Eases sprawl

Figure 26. Montgomery Farm, Field Data, maps, photos

Legend: Yellow=Montgomery Farm (MF) development, Orange=MF Easement Green=Connemara Meadow Land is not part of MF

4.4.2 Interview data. A wide range of respondents participated. Respondents were considered experts in their field and together, total 290 years of multi-disciplinary experience which in turn provides depth and richness to the research findings. The following section places the domains into each of the four areas addressed in the interviews.

4.4.2.1. Conservation subdivisions. The main theme that surfaced concerning CS in North Central Texas is summarized as: residents are attracted to CS for reasons other than conservation and advertising for CS is market driven to respond to those desires. The allure for CS is more likely associated with amenities for green space, separation, and views. Respondents spoke of a desire for views of trees, water, privacy, and that small species give the connection to nature that people seek. For example, in reference to Chimney Rock, Respondent 13 stated, "the selling point here was, and is, the separation, the quiet, the calm." Respondent 5 noted, "they love the trees but have no affinity for wildlife." Another respondent noted an affinity for base-level creatures probably due to growing up seeing "Bambi" in the movies. In addition, it was thought that CS development is marketed for its green space as an amenity rather than for conservation goals. This was expressed by Respondent 9, stating "there is no real specific definition or metric concerning wildlife habitat or waterways". Furthermore, it was expressed that realtors highlight the open space rather than conservation aspects of CS (Respondent 9).

If marketing is focused on open space amenities, conservation becomes secondary to developer profit which was expressed by Respondent 5 speaking of the developer, Green Brick, "that get's it…because he makes more money [in conservation development]." The respondent stated, "primarily [people] are looking for a box with amenities on the inside…with very few amenities on the outside", however, Green Brick has figured out how to make outside amenities work in the North Central Texas market-driven economy. Respondent 8 summed this issue up in the term development often uses for CS, "double-green," whereas CS development homes sell at high premiums and are marketed as eco-friendly.

There was consensus that people are attracted to open space. However, they also need "separation" rising from the need to feel "safe." The topic of separation appeared many times in the interviews whereas the notion of nature happens "over there" rather than up close to people. Some these feelings were felt to arise from the "urbanization" of our culture as expressed by Respondent 3 explaining that people today do not understand wildlife. Respondent 7 expressed this notion as "they want to be out

in nature until nature shows up." In response to needs of separation from wildlife manifesting in successful design elements, Respondent 5 mentioned using overlooks into natural areas as one possible solution. Respondents 2 suggests that possible design elements that give nature experiences yet use separation in CS are achievable by implementing mowed prairie edges to give a sense of manageability. Educational elements were also noted as necessary as either interpretive/informational signage and post-construction education. Fear plays into the need for separation and is addressed in Section 4.4.2.4.

In summary, conservation subdivisions were most often associated with an affinity for green space and privacy rather than conservation and are primarily marketed towards market-driven factors reflecting such. The market is the main driving force, so builders need to see the profitability in developing them. Respondent 2 chimes in stating, "you have to find the hook….and then show them [builders] it [conservation or ecosystem service design] is profitable." The following section addresses urban carnivores in the North Central Texas suburbs.

4.4.2.2 Urban carnivores in North Central Texas suburbs (Figure 27). The main themes that emerged concerning urban carnivores dealt with their adaptability in the suburbs, their habitat

Figure 27. Little Elm neighborhood street gutter drain with bobcats (Source: Sharon.Blunt), River Legacy Park, Arlington; bobcat with prey (Source: Nancy McIlroy)

preferences, and CS residents' tolerance levels associated with their presence. Habitat will be addressed in Section 4.4.2.3.

All respondents felt that urban carnivores were highly adaptable with one referencing in-depth studies by Stanley Gerht and spoke of how bobcats have learned to use city drainage sewer pipes as mobility corridors and coyotes have learned to wait for passing traffic before crossing streets (Respondent 8). Respondent 7 referred to Julie Golla's Fort Worth bobcat tracking study ("Bobcats are par for the (golf) course in North Texas | Fort Worth Star-Telegram," n.d.) in which one bobcat was shown to repeatedly return to a church parking lot planter as a favored sleeping place. He also stated that urban carnivores are not negatively affected by recent drought conditions as water sources are more than adequate for wildlife in the city.

The data suggest that tolerance levels vary and people are generally more interested in bobcats over coyotes. CS residents tend towards higher tolerance or wildlife acceptance capacity than most people, and that experience regarding urban carnivores affects attitudes. Urban carnivores elicit a variety of reactions. For instance, Respondent 14 posts photos of bobcats captured on webcams to their neighborhood website. However, Respondent 13 felt "coyotes are mangy." Respondent 5 asserts that people, in general, assess "wildlife as icky." Overall, it was perceived that CS residents exhibited more acceptance and tolerance than residents in traditional neighborhoods reflected in the sentiment as all three HOA respondents mentioned they felt the animals were part of the "deal" and all interviewees expressed they understood urban carnivores place in urban ecology. Respondent 7, as did a few others, specifically mentioned carnivores ecological service pertaining to rodent and rabbit control. A conflicting view was presented by Respondent 7, who reported most city complaints come from higher income housing areas [this may not be related to CS, however.] He also noted that social media spreads misinformation quickly concerning these animals and that representatives are no longer able to get ahead of a misrepresented story and "cherry pick" reporters that you trust to relay the issue correctly. Viewpoints concerning urban carnivores depend on education and exposure to the animals as expressed by half of the respondents.

4.4.2.3 Urban carnivore habitat (Figure 28). The primary findings on perceptions of urban carnivore habitat focused on their need for cover and methods of navigation. Previous research supports that urban carnivores prefer, yet do not require, natural cover (understory) and separated mobility

corridors. They also seek out hiding places and are wary of people. All 14 respondents corroborated this information.

Respondent 8, explained that urban carnivores typically favor good cover in large golf course areas where they can live in forested areas but look out over the greens. He further states the top three carnivore species in the study area, bobcats, coyotes, and foxes are ”highly adaptable generalists…they can live almost anywhere and eat almost anything.”

Figure 28. Coyote with mange, researcher's residence, Plano, Coyote with a dog companion, Trinity Forest, South Dallas (Source: Phil Plank).”

Design elements considered important for carnivore habitat in the city also focused mainly on cover. Respondent 11 states, “by definition, wildlife needs a place to hide.” He also points out humans need a place to hide as well which alludes to the issue of separation discussed in the previous section. Furthermore, appropriate cover for the region implies native vegetation which provides a varied diet for wildlife compared to natural areas invaded by invasive species (Respondent 8). The diversity wildlife specialist specifically pointed out that density characteristics that favor protection for urban carnivores would meet understory height requirements of four feet and lack of visibility from an outer edge of about six feet.

4.4.2.4 Conservation subdivisions as habitat for urban carnivores. The main themes that appeared regarding the viability of conservation subdivisions as habitat for urban carnivores primarily responded to perceptions of fear. Secondary issues were related to the structure of policy, easements, and the subdivisions themselves. This section of the interview presented the respondents with

photographs divided into two groups to gauge possible marketing strategy for CS habitat (Figure 21, p.64). Group One photos presented bobcats and coyote in naturalistic settings whereas, Group Two photos presented the animals in either neighborhood yards or common areas. Reactions to urban carnivore images as a marketing strategy were mixed. There was general consensus that utilizing coyote photos would be a disincentive for marketing as relayed by Respondent 13 that said, “not only no, but hell no!” All 14 participants reasoned that photos of coyotes illicit fear due to safety concerns for small children and pets. However, all respondents also felt safety from urban carnivores was the owner’s responsibility and respondents understood the risk of safety issues concerning urban carnivores are actually rather low. In addition, as reported by Respondent 7, social media compounds these fears. Five respondents would not use any of the photos shown. Respondents were more accepting to the possibility of using Group One photos of bobcats in natural settings reflecting the sense that bobcats are a bit enchanting. Respondent 7 pondered that viewing of a bobcat photos might trigger curiosity. More than half of the respondents referred to past upbringing or exposure to wildlife as influencing safety perceptions and favored educational efforts to counteract fears.

How CS perform as urban carnivore habitat was reported to depend on regional policy and how the subdivision structure is initially set up and implemented. Policy and structure were addressed in terms of overall habitat rather than specific to urban carnivores. The data suggests conservation [habitat] goals versus achievement of those goals are not realized due to challenges concerning resident desire for green spaces and that it is market-driven not conservation- driven development. Respondent 5 speaks directly to the role of government affirming that unless CS is backed by regional or city policy, it will not gain popularity. Several respondents pointed out the fact that land trusts are only responsible for the legal aspect of conservation easements. This means they have legal right to take the land owner to court to enforce the terms of the easement. They “are not in the maintenance business,” recounted Respondent 10.

Furthermore, the development process affects the quality of CS habitat. During the design process, environmental assessments were felt to be important as were good maintenance plans, including the means of enforcing them, both financially and physically. Respondent 6 spoke in detail concerning these needs and specifically stated that he wrote his last book, *Rural by Design*, with graduate students in mind. He referred to Chapter 19, specifically mentioning the needs for management

plans for CS. They explain the who, what, how, and when task tasks should be accomplished. The respondent also stated planning accreditation boards that set landscape standards for what is being taught in graduate school are ignorant of these issues.

Post-construction maintenance plans and education were also felt to be contributing factors to where CS were successful in providing quality habitat. Respondent 8 noted that many second and third time buyers in CS “don’t get the same training about the conservation land and easement requirements that first buyer had from the developer” therefore, important conservation information is lost without on-going training. All three HOA respondents responded that there was no clear direction for maintenance or supplemental educational programs in place to inform CS residents. Respondent 11 mentioned education programs offered through The Connemara Conservancy which holds all CS easements in the study area, however, a review of their public webpage fails to reflect any such offerings at this time. Programs offered to appear to favor developers or private landowners interested in learning more about conservation easement parameters.

4.5 Summary. This chapter documented findings according to respondents’ perceptions of conservation subdivisions as viable habitat for urban carnivores in the study area by examining respondent perceptions regarding CS as habitat for urban carnivores. Data collected from phone interviews and field data revealed overall themes and patterns in response to the research questions which revealed main domains concerning how people feel about CS and habitat related to urban carnivores. Those Domains were primarily concerned with fear, education and background exposure related to those topics which also affects preferences. CS habitat success was found to be dependent on the structure of both policy and the design of post-construction maintenance plans.

Chapter 5: Conclusions & Discussion

This chapter provides discussion and comparisons to the literature review regarding the findings indicating respondents' perceptions regarding the viability of CS as urban carnivore habitat in the North Central Texas suburban area. A brief overview of the primary questions is summarized. The discussion precedes a brief overview of the study's relevance to the professions of landscape architecture and concludes with recommendations for further research.

5.1 Findings

The data suggest CS are currently functioning as viable habitat for urban carnivores due to bobcats', coyotes,' and foxes' high adaptability to suburbia (Figure 29).

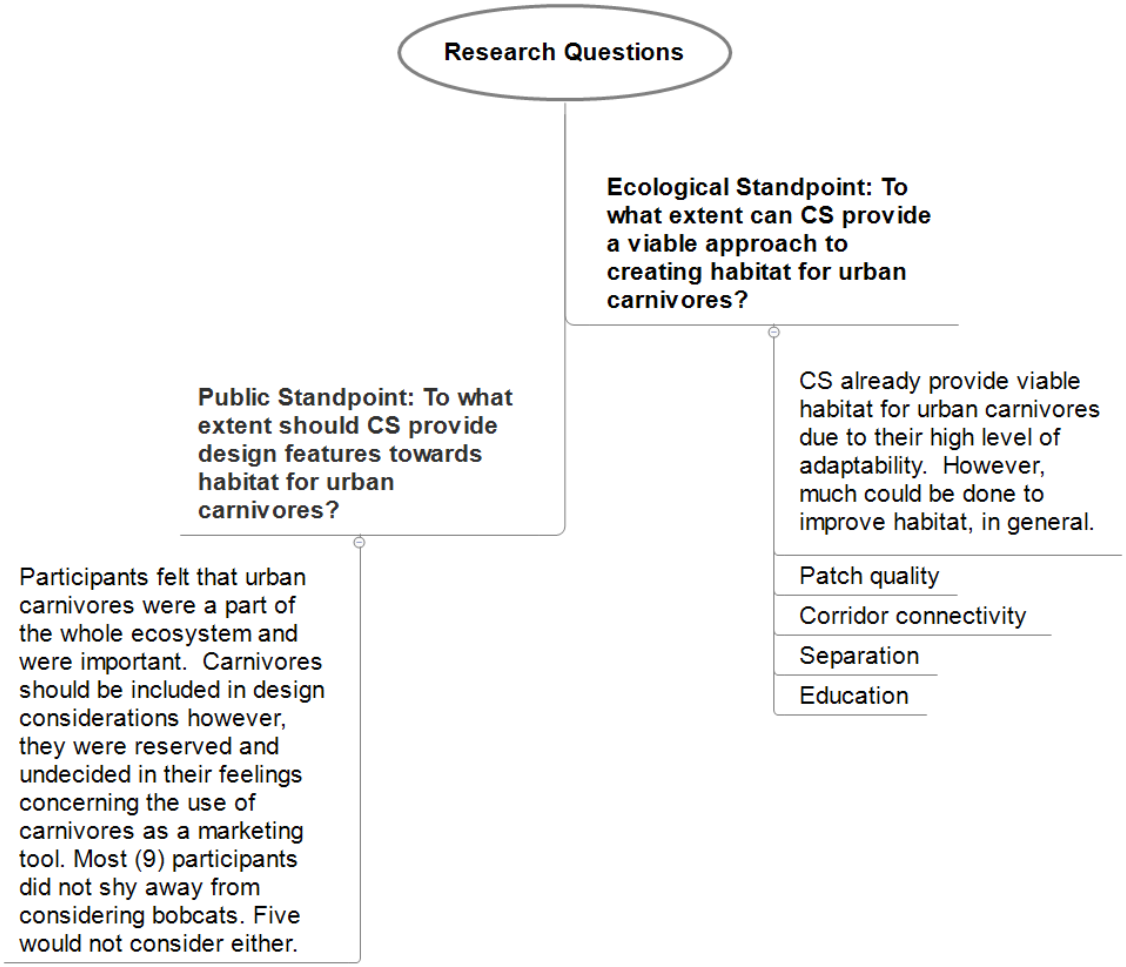


Figure 29. Research questions, findings diagram

CS habitat could, however, be improved to offer increased attractiveness by offering more connectivity, higher patch quality, separation (for both the animals and people), and by providing educational programs and better post-construction maintenance plans. Furthermore, both residents and field experts interviewed supported urban carnivores in the mix of urban ecology and felt that they were accepted and understood as part of the package in conservation areas as well as, the urban ecology on the whole. Regarding public perception, the data support it may be counter-productive to use urban carnivores in marketing materials. However, nine respondents pondered the use of bobcat images in natural habitats which should be considered as a topic for future research.

5.2 Discussion and Literature

The findings from the study support several topics conveyed in the literature review. The discussion is organized by the main sections addressed in the interviews:

1. Conservation subdivisions,
2. Urban carnivores and their habitat, and
3. Conservation subdivisions as habitat for urban carnivores.

5.2.1 Conservation subdivisions. Based on the literature review and respondent information, policy structure was mentioned as a limiting factor in CS development. A comprehensive regional policy that takes into consideration bioregional planning (similar to California or Florida) was presented as an alternative to current North Central Texas structure. The Austin area Capitol Area Councils of Government has a conservation plan. The DFW area NCTCOG does not. Even with one in place, city and county participation is voluntary. Several respondents mentioned the “nature over there” mentality in which nature is at state parks or away from our homes. This mentality keeps communities and individuals from interacting with nature close to home. Attention to natural habitats or even constructed habitats in their yards or within their reach within their communities is overlooked. If regional entities were to adopt the bioregionalism approach to design, it would improve and focus site-specific to regional level efforts to encompass the entire ecological web in designing our communities. Also, public perceptions concerning wildlife potentially either encourage or discourage a bioregionalism mentality.

Past research indicates that people are drawn to green spaces. Respondents enforced this notion explaining that homebuyers are drawn to outdoor amenities such as trees, water features, privacy,

preserved spaces, and vistas. Desired elements are not, however, necessarily aligned with conservation. Conservation presents as secondary or coincidental. Respondents also confirmed that CS home values reflect those desired amenities in market premiums which are also supported in the literature.

5.2.2 Urban carnivores and their habitat. Urban carnivores in North Central Texas suburbs are represented as highly adaptable animals and prefer natural areas. They also and perform ecosystem services and incite fear. All respondents exhibited knowledge of urban carnivore habitat in suburban areas and some cited literature presented in Chapter 2.

Particular to urban carnivores, this study shows that images of coyotes and bobcats should not be used in marketing efforts as they may incite fear. However, as one respondent noted, “we are in the middle of a cultural transition.” For instance, the recently published article refers to Dallas as “Bobcat City” (“Welcome to Bobcat City U.S.A.,” 2017). In addition, the UTA architecture department has started referring to and promoting “Wild Dallas” concerning the Trinity River Renovation Project in downtown Dallas that focuses on the concept of re-engaging with nature around the Trinity waterways utilizing the entire water network. Furthermore, social media makes for an easily user-friendly means for communication, and therefore the public sees an increase of references to carnivores in general. Fear was one of the most frequent codes applied in the analysis. Respondents spoke of fears from ticks and snakes in Texas, to alligators in Florida, and bears in Colorado. The consensus is, people are afraid of what they do not understand. However, everyone also stated they were intrigued or curious about bobcats and coyotes except one resident that stated “coyotes are mangy.” It may be that that people are not as afraid as the media portrays. For instance, 911 Wildlife receives calls about bobcats and coyotes daily from all over the metroplex, yet 99% of those calls are what they label ‘phone solves”. 911Wildlife educates the caller, and the caller leaves the conversation with new information and appears to accept the information with little resistance. Concern or ignorance may be conflated with real fear. In reality, people may be inquiring to settle their curiosity about an urban carnivore sighting or out of healthy concern which does not equate with fear. However, they may be in a deciding stage as to whether they need to be afraid or not. This is an optimal time to help form perceptions about urban carnivores and other urban wildlife. Once educated on the phone, the callers appear to be satisfied. Along with the notion of designers needing to “set the hook” as one informant mentioned, there is also need to find the tipping point where a community starts to accept apex predators and work towards wildlife acceptance

capacity. This task is usually left to urban biologists and companies such as 911Wildlife as they educate the community. If this type of education was part of the design processes, it might increase the likelihood that conservation designs will be more successful from the standpoint of urban wilding using a biodiversity-ecosystem framework approach.

Awareness of apex predator-human coexistence in countries outside the United States may shift cultural transitions further. The recent airing of BBC's "Cities," reveals hyenas in Ethiopia entering the market center after dark to perform an ecological benefit of digesting the discarded bones of a local butcher. Education in how other countries coexist with apex predators in urban or suburban areas may offer insight into ways suburbia may benefit from urban carnivores' services not before considered.

5.2.3 Conservation subdivisions as habitat for urban carnivores. Without detailed case studies and specific quantitative data involving animal tracking, it is difficult to say precisely how DFW conservation subdivisions perform as apex carnivore habitat. In addition, urban carnivores are highly adaptable animals. Research shows these animals are living within feet of humans and go undetected much of the time (Gehrt et al., 2010; Tigas et al., 2002). However, based on known available research on these animals, their preferences, and the study field data gathered, the subdivisions should perform better than traditional subdivisions without natural patches.

Based on the interview data gathered, residents and experts report a high frequency of urban wildlife activity adjacent to the corridors. They also report an influx of invasive plants such as green briar with no clear plan on how to address conservation concerns. To meet conservation objectives, specific post-construction maintenance plans must be in place. Furthermore, conservation subdivision design should place more attention on the entire food web in an urban ecosystem. A focus on apex predators down to level one base animals would by definition focus on an entire food web system. Rodenticides should also be included in the food cycle because they are shown to increase mange and mortality in both bobcats and coyotes (Poessel, Breck, Fox, & Gese, 2014; Riley et al., 2007). This points to using a biodiversity-ecosystems framework (BEF) approach to design and planning which is essential a bioregionalism approach to design. The EPA and TPWD provide detailed maps and plans for ecoregion planning. The challenge is understanding the market associated with pushing a bioregional model and working within those parameters. This is not an easy task as it encompasses a shift in cultural norms,

such as landscaping with natives or polycultures rather than readily available invasive plants, for example.

Focus not only on the design stage but also on the implementation of post-construction habitat maintenance plans that support conservation rather than natural states is important. Many CS revert to natural states that are overrun with invasive species. Natural states do not equal conservation states. All respondents referred to a need for post-construction maintenance plans as important yet; the field data notes none in place. The literature review indicates that a majority of CS failure regarding conservation is directly correlated with a lack of actionable post-construction strategies in place for CS habitat.

Regional policy structure also bares implementation of CS development in the study area as a popular alternative to traditional development. The Texas state-wide mentality of a market-driven model concerning land ownership was stated as a reason. Respondent 5 mentioned that "until policy demands more conservation, those types of developments are not going to be popular… they just are not going to happen." For instance, the situation surrounding the development of Montgomery Farm was initiated in long time family tie to the land. There was a historical family attachment to the land. Therefore, the Gardens of Connemara within Montgomery Farm was developed as a conservation area adjacent to donated land from the same family to Connemara Conservancy to remain as undeveloped. The other instance in which CS in Texas is developed is due to developer understanding how to turn conservation land into an amenity for homebuyers which in turn, increases their profit margins".

Finally, communities do not tend to think of design in terms of biodiversity and extinction rates. Talking and thinking about the sixth mass extinction is not popular. Some LAs do tackle HIPPO issues in design. However, if there is a disconnect as to "why" those ecosystem services or elements should be addressed, the reason for resilient design loses its perception of importance and momentum. This topic may be alarming to consider. However, is it a responsibility of LAs as land stewards to bridge the gap when one is uncovered.

5.3 Importance to the profession for Landscape Architects

Psychologically speaking, humans tend to think using different processes. Some people tend to compartmentalize processes or issues whereas others tend to think in terms of everything being connected in one way or another. Rozuel, (2011) argues compartmentalization does not sustain ethical

scrutiny. The reality is that ecological systems are far more complicated than we can focus on in the design process. Therefore, landscape architects and planners simplify the process for design and focus on the compartments of the system. However, their role as land stewards, LAs make ethical decisions concerning the environment able to act as the potential integrators who funnel and focus a multitude of disciplines towards common environmental objectives. For example, the 2010 Dumbarton Oaks Garden and Landscape Studies Symposium gathered to discuss what role LAs play in conserving or restoring wildlife diversity. Organizers argued that

> "Landscape architects have a key role to play through "reserve design for focal species and biodiversity; sizing and spacing of habitat patches, corridors, and edge conditions; and the analysis of food webs and predator-prey dynamics…ecosystem services, restoration ecology, and designer-generated ecological experiments all provide new opportunities for landscape architects in developing productive wildlife habitats" (Green, 2010).

Even with the best intentions, CS design lacks follow-though. Conservation design and post-construction campaign strategies may be the best indicators of design success regarding habitat. It is up to the landscape architecture profession to set design examples and continue to educate and encourage green infrastructure planning and sustainable, resilient design within the industry. In the face of HIPPO threats and changing climate conditions, we must promote and educate the community at all design levels (from small residential sites to regional environmental planning). Research suggest, unless we start making big changes, our ecological diversity will be lost much faster than previously anticipated in past times.

5.4 Future Research

Over the course of investigating current literature and exploring topics related to conservation subdivisions, several questions arose that offer an opportunity for future research. Further research questions are categorized in the areas of promotion, assessment, perceptions, implications, and alternatives.

5.4.1 Promotion. Future research in the area of promotion include the following:

The use of terminology related to conservation design and development allows for confusion. There is no apparent standard for use between municipalities. For instance, the city of Dallas uses the term conservation districts which have nothing to do with conserving habitat - it is historical/cultural in nature. Whereas, the Flower Mound Conservation District refers directly to CS development. How

should the terminology of CS be clarified for North Central Texas?? Also, terms for CS, CD, and clustering are often used interchangeably, which causes confusion.

Both the literature review and findings in this study indicate a lack of actionable strategies for post-construction habitat implementation. How can LAs both lead and follow by adapting design methodologies to conserve or restore natural systems in support of urban wildlife habitat within conservation subdivision design?

5.4.2 Assessment. Future research in the area of assessment include the following:

Wildlife mobility is hindered with the rise of fragmentation. What are the possibilities for CS to contribute to survival, specifically regarding wildlife mobility in the face of climate change?

Case studies of Flower Mound and Allen should be completed to give further information and insight regarding their performance post-construction and how they may be improved. How do each CS within the study area perform has wildlife habitat using Table 3 questions (the conservation subdivision wildlife habitat checklist formulated by Hostetler and Drake, (2009). Also, research on CS in the study is lacking. Case studies should include questions on how are CS in North Texas monitored and maintained and what are the relevant standards?

As land trusts are not the business maintenance and offer little assistance and the expensive nature of post-construction maintenance costs, how can CS land be better funded towards maintenance?

How can wildlife monitoring practices for CS be linked to scientific studies to provide science-based decisions about CS? There exists research on what CS should do post-construction that would provide basis.

5.4.3 Perceptions. Future research in the area of perceptions include the following:

An ASLA 2014, survey of 179 LAs expectations regarding most popular landscaping features reports low-maintenance landscapes come in first place at 95% and native plants, second at 85%. Xeriscaping/dry gardens come in fifth at 69 percent (O'Malley, 2014). To what extent are residents willing to be restricted to plants on an approved list of natives, for CS? Also, to what extent are residents willing to wildlife certify or at least follow designing for wildlife principles as described by (Hostetler, 2010) perhaps with an incentive of some kind?

There is resistance to change, and acceptance of new ideas takes place over time. What are the possible causes for resistance to CS in North Texas? With greening trends, will more CS be expected to develop? See Article, ‘Builders prepare for a warmer world,' (author/cheryl-weber, 2016).

Research in countries outside the U.S. suggests some large species wildlife coexists with humans on a level that would be perceived as impossible in the DFW suburban area. To what magnitude would North Central Texas perceptions respond to exposed practices in other countries?

Finally, there seems to be a disconnect in studies concerning wildlife fear and what resident’s real feelings in DFW. The researcher’s perception for Plano and Allen, possibly not Richardson was that residents appear more curious than afraid of carnivores. To what extent do beliefs about urban carnivore perceptions actually manifest as fear?

5.4.4 Implications. Future research in the area of implications include the following:

Based on strategic CS planning for patch and corridor conservation, to what extent do studies show that increased patches would predict an increase in grassland butterflies, birds, or flora dispersal rates?

One responded noted that SITES is the way of the future. What are the implications of integrating Landscape for Life programs within conservation subdivisions (“Home | SITES,” n.d., “Home Builders Are Bullish on Sustainability | Builder Magazine | Green Technology, Green Building, Green Builders, Energy-Efficient Design, Energy-Efficient Construction, Energy Efficiency, Energy Star, Jacob Atalla, KB Home, Greenbuild,” n.d.).

“Double-green” as a term referred to in the interviews. To what extent do builders in North Texas understand the “faulty logic” with build first, ecology later and the implications for conservation within CS? (“Intentional Grounding | Builder Magazine | Development, Land, Government Projects, Lots, Developers, Big Builder,” n.d.). Also, what is the magnitude of conservation understanding implied within the term “double-green?”

In response to potential acceptance of urban carnivore-human interactions, what would be possible in the DFW area if communities were to raise their level of education to affect acceptance levels to welcome carnivores resulting benefit from the services provided to the urban ecological framework?

5.4.5 Alternatives. Future research in the area of alternatives to CS design includes the following:

Parks and unplanned nature areas are often overlooked as potential wildlife habitat areas that could be better managed to provide quality patches for suburban wildlife. Are there viable alternatives to increase natural green space and park patch and corridor quality to the benefit of urban wildlife? Specific to apex carnivores, they prefer to hide in cover, but research also suggests a preference for open space for hunting grounds. What retroactive measures could be taken towards increasing habitat quality? Are developers in North Texas implementing the other three types of conservation development techniques?

Finally, resilient design takes into account biodiversity loss, drought, extreme heat, fire, flooding, and landslides. As CD already takes this into account based on the operational definition. How is land disturbance minimized? One respondent involved with Chimney Rock construction noted that during the construction phase, several practices affected the integrity of the project. Construction crews dumped two feet of fill dirt on the open space that was to be preserved as prairie. In addition, the cultural landmark was disassembled and reassembled in another area and was not put back together correctly. It was not intended to be relocated. Furthermore, what would be then next step to explore CS as a model for resilient design practice (Glicksman, 2009; “Resilient Design | asla.org,” n.d.).

5.5 Closing Remarks

Chapter 5 began by analyzing and interpreting the data and themes documented in Chapter 4, to summarize the findings according to the original research questions of this study. Following the analysis, there was a discussion regarding comparisons found in both the literature review and the interview findings. The discussion subsequently led to the relevance of the research findings to the profession of landscape architecture and ended with recommendations for future research. Overall, the research revealed a favorable opinion among respondents regarding conservation subdivisions as viable habitat for urban carnivores. They expressed an understanding that apex mammals are a necessary part of urban ecology and they provide ecosystem benefits. It was revealed that CS in the study area might not be living up to the conservation objectives due to a lack of long-term conservation-focused maintenance plans. In some cases, it is apparent that residents are ill-informed and act on misinformation concerning their land. The more that is understood concerning how current

North Central Texas conservation design is maintained and is achieving its objectives after implementation, the better position the profession is situated to affect lasting environmental change.

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Biographical Information

Sherry Fabricant holds Bachelor's Degree in both Business Administration, Management and Liberal Arts, Psychology from The University of Texas at Austin. Ms. Fabricant is a life-long civic volunteer with current certifications in the Texas AgriLife Extension affiliated Texas Master Gardener program, Collin County chapter, and the Texas Parks and Wildlife Department affiliated Texas Master Naturalist program, Blackland Prairie chapter. In addition, she is a certified member of the Texas Stream Team providing citizen science data for statewide water quality reporting. She also volunteers at The Connemara Conservancy working with prairie quail reintroduction and meadow restoration. Her interest in environmental matters led her to choose a thesis topic related to conserving habitat within the built environment. During her graduate work at The University of Texas at Arlington, she submitted two projects that received national and state recognition. Her urban design studio team placed first in the master plan category of the 2015 EPA Campus Rainworks Challenge, a national design competition with entries from twenty-six states and seventy-seven teams overall. The project also received an Honor Award from Texas ASLA. Ms. Fabricant-Wood's site planning studio design team received a 2013 Texas ASLA Honor Award for their project on the Alcuin School in Dallas, Texas.

Ms. Fabricant-Wood continues to volunteer with a focus on urban wildlife diversity and plans to pursue future endeavors in the environmental design arena.

Appendices

A. IRB

UNIVERSITY OF TEXAS ARLINGTON | OFFICE OF RESEARCH ADMINISTRATION
REGULATORY SERVICES

Institutional Review Board
Notification of Exemption

February 16, 2017

Sherry Lynn Fabricant
Dr. David D. Hopman
Architecture
The University of Texas at Arlington
Box 19108

Protocol Number: 2017-0165

Protocol Title: *The Viability of Conservation Subdivisions as Habitat for Urban Carnivores in North Central Texas Suburbs*

EXEMPTION DETERMINATION

The UT Arlington Institutional Review Board (IRB) Chair, or designee, has reviewed the above referenced study and found that it qualified for exemption under the federal guidelines for the protection of human subjects as referenced at Title 45CFR Part 46.101(b)(2).

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:(i) information obtained is recorded in such a manner that human subjects can be identified, either directly or through identifiers linked to the subject; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

You are therefore authorized to begin the research as of **February 16, 2017**.

Pursuant to Title 45 CFR 46.103(b)(4)(iii), investigators are required to, "promptly report to the IRB ***any*** proposed changes in the research activity, and to ensure that such changes in approved research, during the period for which IRB approval has already been given, are **not initiated without prior IRB review and approval** except when necessary to eliminate apparent immediate hazards to the subject." All proposed changes to the research must be submitted via the electronic submission system prior to implementation. Please also be advised that as the principal investigator, you are required to report local adverse (unanticipated) events to the Office of Research Administration; Regulatory Services within 24 hours of the occurrence or upon acknowledgement of the occurrence. All investigators and key personnel identified in the protocol must have documented Human Subject Protection (HSP) Training on file with this office. Completion certificates are valid for 2 years from completion date.

The UT Arlington Office of Research Administration; Regulatory Services appreciates your continuing commitment to the protection of human research subjects. Should you have questions or require further assistance, please contact Regulatory Services at regulatoryservices@uta.edu or 817-272-2105.

REGULATORY SERVICES
SERVICES
The University of Texas at Arlington, Center for Innovation
202 E. Border Street, Ste. 201, Arlington, Texas 76010, Box#19188
(T) 817-272-3723 (F) 817-272-5808 (E) regulatoryservices@uta.edu (W) www.uta.edu/rs

UNIVERSITY OF TEXAS ARLINGTON | OFFICE OF RESEARCH ADMINISTRATION
REGULATORY SERVICES

February 20, 2017

Sherry Lynn Fabricant
Dr. David D. Hopman
Architecture
The University of Texas at Arlington
Box 19108

IRB No.: **2017-0165**

Title: *The Viability of Conservation Subdivisions as Habitat for Urban Carnivores in North Central Texas Suburbs*

EXEMPT MINOR MODIFICATION APPROVAL MEMO

The UT Arlington Institutional Review Board (UTA IRB) Chair (or designee) reviewed and approved the modification(s) to this exempt protocol on **February 20, 2017** in accordance with Title 45 CFR 46.101(b). Therefore, you are authorized to conduct your research. The modification(s), indicated below, was/were deemed minor and appropriate for exempt determination/acknowledgment review.

- Minor changes to the Pre-Interview Operational Definitions and Photos document, including minor text edits and the addition of two photos

Pursuant to Title 45 CFR 46.103(b) (4) (iii), investigators are required to, "promptly report to the IRB ***any*** proposed changes in the research activity, and ensure that such changes in approved research, during the period for which IRB approval has already been given, **are not initiated without IRB review and approval** except when necessary to eliminate apparent immediate hazards to the subject."

The modification approval will additionally be presented to the convened board for full IRB acknowledgment [45 CFR 46.110(c)]. All investigators and key personnel identified in the protocol must have documented Human Subjects Protection (HSP) training on file with the UT Arlington Office of Research Administration; Regulatory Services.

The UT Arlington Office of Research Administration; Regulatory Services appreciates your continuing commitment to the protection of human research subjects. Should you have questions or require further assistance, please contact Regulatory Services at regulatoryservices@uta.edu or 817-272-2105.

UNIVERSITY OF TEXAS ARLINGTON | OFFICE OF RESEARCH ADMINISTRATION REGULATORY SERVICES

March 16, 2017

Sherry Lynn Fabricant
Dr. David D. Hopman
The University of Texas at Arlington
Box 19108

IRB No.: **2017-0165**

Title: *The Viability of Conservation Subdivisions as Habitat for Urban Carnivores in North Central Texas Suburbs*

EXEMPT MINOR MODIFICATION APPROVAL MEMO

The UT Arlington Institutional Review Board (UTA IRB) Chair (or designee) reviewed and approved the modification(s) to this exempt protocol on **March 16, 2017** in accordance with Title 45 CFR 46.101(b). Therefore, you are authorized to conduct your research. The modification(s), indicated below, was/were deemed minor and appropriate for exempt determination/acknowledgment review.

- Modifying consent form in order to request consent to name participants only if they give permission

Pursuant to Title 45 CFR 46.103(b) (4) (iii), investigators are required to, "promptly report to the IRB ***any*** proposed changes in the research activity, and ensure that such changes in approved research, during the period for which IRB approval has already been given, **are not initiated without IRB review and approval** except when necessary to eliminate apparent immediate hazards to the subject."

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The UT Arlington Office of Research Administration; Regulatory Services appreciates your continuing commitment to the protection of human research subjects. Should you have questions or require further assistance, please contact Regulatory Services at regulatoryservices@uta.edu or 817-272-2105.

B. Reference Studies from Figure 11

1. Mussel and barnacle beds have declined or disappeared along parts of the Northwest coast due to higher temperatures and drier conditions that have compressed habitable intertidal space.116
2. Northern flickers arrived at breeding sites earlier in the Northwest in response to temperature changes along migration routes, and egg laying advanced by 1.15 days for every degree increase in temperature, demonstrating that this species has the capacity to adjust their phenology in response to climate change.117
3. Conifers in many western forests have experienced mortality rates of up to 87% from warming-induced changes in the prevalence of pests and pathogens and stress from drought.118
4. Butterflies that have adapted to specific oak species have not been able to colonize new tree species when climate change-induced tree migration changes local forest types, potentially hindering adaptation.119
5. In response to climate-related habitat change, many small mammal species have altered their elevation ranges, with lower-elevation species expanding their ranges and higher-elevation species contracting their ranges.120
6. *Northern spotted owl populations in Arizona and New Mexico are projected to decline during the next century and are at high risk for extinction due to hotter, drier conditions, while the southern California population is not projected to be sensitive to future climatic changes.*121
7. Quaking aspen-dominated systems are experiencing declines in the western U.S. after stress due to climate-induced drought conditions during the last decade.122
8. Warmer and drier conditions during the early growing season in high-elevation habitats in Colorado are disrupting the timing of various flowering patterns, with potential impacts on many important plant-pollinator relationships.77
9. *Population fragmentation of wolverines in the northern Cascades and Rocky Mountains is expected to increase as spring snow cover retreats over the coming century.*123
10. *Cutthroat trout populations in the western U.S. are projected to decline by up to 58%, and total trout habitat in the same region is projected to decline by 47%, due to increasing temperatures, seasonal shifts in precipitation, and negative interactions with non-native species.*8
11. Comparisons of historical and recent first flowering dates for 178 plant species from North Dakota showed significant shifts occurred in over 40% of species examined, with the greatest changes observed during the two warmest years of the study.75
12. Variation in the timing and magnitude of precipitation due to climate change was found to decrease the nutritional quality of grasses, and consequently reduce weight gain of bison in the Konza Prairie in Kansas and the Tallgrass Prairie Preserve in Oklahoma.124 Results provide insight into how climate change will affect grazer population dynamics in the future.
13. (a and b) Climatic fluctuations were found to influence mate selection and increase the probability of infidelity in birds that are normally socially monogamous, increasing the gene exchange and the likelihood of offspring survival.125
14. Migratory birds monitored in Minnesota over a 40-year period showed significantly earlier arrival dates, particularly in short-distance migrants, indicating that some species are capable of responding to increasing winter temperatures better than others.126
15. *Up to 50% turnover in amphibian species is projected in the eastern U.S. by 2100, including the northern leopard frog, which is projected to experience poleward and elevational range shifts in response to climatic changes in the latter quarter of the century.*127
16. *Studies of black ratsnake (Elaphe obsoleta) populations at different latitudes in Canada, Illinois, and Texas suggest that snake populations, particularly in the northern part of their range, could benefit from rising temperatures if there are no negative impacts on their habitat and prey.*128
17. Warming-induced hybridization was detected between southern and northern flying squirrels in the Great Lakes region of Ontario, Canada, and in Pennsylvania after a series of warm winters created more overlap in their habitat range, potentially acting to increase population persistence under climate change.129
18. Some warm-water fishes have moved northwards, and some tropical and subtropical fishes in the northern Gulf of Mexico have increased in temperate ocean habitat.130 Similar shifts and invasions have been documented in Long Island Sound and Narragansett Bay in the Atlantic.131

19. *Global marine mammal diversity is projected to decline at lower latitudes and increase at higher latitudes due to changes in temperatures and sea ice, with complete loss of optimal habitat for as many as 11 species by mid-century; seal populations living in tropical and temperate waters are particularly at risk to future declines.*132
20. Higher nighttime temperatures and cumulative seasonal rainfalls were correlated with changes in the arrival times of amphibians to wetland breeding sites in South Carolina over a 30-year time period (1978-2008).133
21. Seedling survival of nearly 20 resident and migrant tree species decreased during years of lower rainfall in the Southern Appalachians and the Piedmont areas, indicating that reductions in native species and limited replacement by invading species were likely under climate change.134
22. Widespread declines in body size of resident and migrant birds at a bird-banding station in western Pennsylvania were documented over a 40-year period; body sizes of breeding adults were negatively correlated with mean regional temperatures from the preceding year.85
23. Over the last 130 years (1880-2010), native bees have advanced their spring arrival in the northeastern U.S. by an average of 10 days, primarily due to increased warming. Plants have also showed a trend of earlier blooming, thus helping preserve the synchrony in timing between plants and pollinators.135
24. In the Northwest Atlantic, 24 out of 36 commercially exploited fish stocks showed significant range (latitudinal and depth) shifts between 1968 and 2007 in response to increased sea surface and bottom temperatures.55
25. Increases in maximum, and decreases in the annual variability of, sea surface temperatures in the North Atlantic Ocean have promoted growth of small phytoplankton and led to a reorganization in the species composition of primary (phytoplankton) and secondary (zooplankton) producers.136
26. Changes in female polar bear reproductive success (decreased litter mass and numbers of yearlings) along the north Alaska coast have been linked to changes in body size and/or body condition following years with lower availability of optimal sea ice habitat.137
27. Water temperature data and observations of migration behaviors over a 34-year time period showed that adult pink salmon migrated earlier into Alaskan creeks, and fry advanced the timing of migration out to sea. Shifts in migration timing may increase the potential for a mismatch in optimal environmental conditions for early life stages, and continued warming trends will likely increase pre-spawning mortality and egg mortality rates.87
28. Warmer springs in Alaska have caused earlier onset of plant emergence, and decreased spatial variation in growth and availability of forage to breeding caribou. This ultimately reduced calving success in caribou populations.138
29. *Many Hawaiian mountain vegetation types were found to vary in their sensitivity to changes in moisture availability; consequently, climate change will likely influence elevation-related vegetation patterns in this region.*139
30. *Sea level is predicted to rise by 1.6 to 3.3 feet in Hawaiian waters by 2100, consistent with global projections of 1 to 4 feet of sea level rise (see Ch. 2: Our Changing Climate, Key Message 10). This is projected to increase wave heights, the duration of turbidity, and the amount of re-suspended sediment in the water; consequently, this will create potentially stressful conditions for coral reef communities.*140

C. Conservation Development Plans in Texas

US Rank	Texas Rank MSA	Ordinance or Vision plan
4	**1 Dallas-Fort Worth**	• No codes found • **NCTCOG** – VNT 2030 – Natural Assets sub-topic ("RegChoices_NorthTexas2030.pdf," n.d.-b) • The City of Flower Mound – Cross Timbers Conservation Development Districts Area Plan – Open Space Plan ("7481," n.d.) addresses conservation subdivisions • Ellis County – Draft found ("Microsoft Word - TEMPLATE - WORK IN PROGRESS - Ellis County Development Regulations.doc - TEMPLATE-EllisCountyDevelopmentRegulations.pdf," n.d.) • Rockwall County: conservation visioning – found conservation easements but not subdivisions ("Environment & Development - nctcog.org," n.d.-b)
5	**2 Houston**	• No codes found • **Houston-Galveston Area Council** – mentions natural assets but nothing specific to subdivisions ("eco-logical-report.pdf," n.d.)
25	**3 San Antonio**	Code found: San Antonio 2010, updated sept 2016 ("Sec. 35-203. - Conservation Subdivision. | Unified Development Code | San Antonio, TX | Municode Library," n.d.) **Alamo Area COG**: No mention found: ("Agency Documents | Alamo Area Council of Governments, TX," n.d.)
35	**4 Austin**	**City of Austin**: Does not currently have articles for conservation subdivisions, however, they do have a request to revise their code to revise the articles to include them ("Subdivision Regulations Revisions | AustinTexas.gov - The Official Website of the City of Austin," n.d.) **Capital Area Council of Governments** – Central Texas Regional Greenprint for Growth recommends Conservation Subdivisions specific to its counties. Development ordinances are also addressed: ("2009-11-03 County Land Use Report - final for Publication.pdf," n.d., "Central Texas," n.d.) • Bastrop County - Guidelines for Participation in the Lost Pines Habitat Conservation Plan("Conservation Subdivision Development Guidelines for Participation in the Lost Pines. Habitat Conservation Plan," n.d.) • Hill Country Alliance for Travis County has codes for unincorporated areas around ("CONSERVATION DEVELOPMENT Travis_County_Conservation_Design_Manual.pdf," n.d.) • Georgetown, ("SECTION 11.06. - CONSERVATION SUBDIVISIONS | Code of Ordinances | Georgetown, TX | Municode Library," n.d.) • Hays County - ("HAYS COUNTY - Download.aspx," n.d.)
67	**5 McAllen**	**Lower Rio Grand Valley COG** - no mention and no code found ("2017-2022 Regional Strategic Plan (Executive Summary) FINAL.pdf," n.d.)
68	**6 El Paso**	**Rio Grande COG** No mention found **-** ("RIO GRANDE COUNCIL OF GOVERNMENTS," n.d.)

Conservation Development Articles or Vision; *Note***:** Open Space Plans for these areas were not examined due to time limitations. Search focused on all 24 TACG and top 6 ranking metropolitan areas in Texas (U. S. C. Bureau, n.d.) Keywords: Texas, conservation development, ordinance, conservation subdivision, and natural assets. Additional keywords that may pull responses noted but not investigated: water conservation.

D. Economics of Conservation Subdivisions

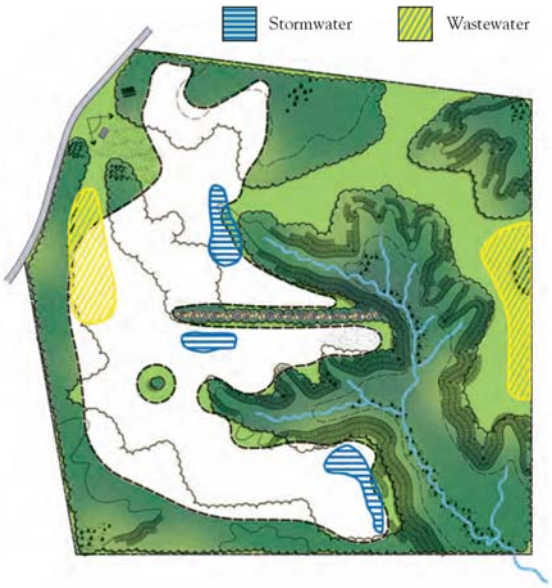
Conservation Subdivisions Development Benefits and Value	**Study Results**
Society Stormwater management	Targeted land preservation decreases stormwater management controls, Maintaining predevelopment hydrology reduces impacts to aquatic ecosystems (Williams & Wise, 2006)
Sensitive habitat protection	Protecting stream buffers reduce urban impacts to water bodies, Large reserves in urban areas increase bird species richness (Alberti et al., 2007; Odell, Theobald, & Knight, 2003; Pickett et al., 2001)
Reduced demand for public parkland	As a substitute for park space, CSD reduced demand (however, typology matters). (Lutzenhiser & Netusil, 2001)
Linking landscapes	Strategically placing conservation subdivisions ensures that landscapes are linked together which in turn benefits wildlife habitat (Arendt, 2004.)
Builders Lower infrastructure costs (builders)	Lots in CSD cost less to build vs. traditional lots, Over 25% savings in construction and infrastructure costs (Anderson & West, 2006, CRI,2005; Mohamed, 2006)
Marketing/sales advantages (builders)	Fills greenspace niches in market, providing alternatives to traditional design (Geoghegan, 2002)
Residents & Builders Increased property value	Lots adjacent to permanently open space sell for a premium (Geoghegan, 2002; Irwin, 2002)
Property value appreciation	Homes in CSDs sell in half the time as those in traditional subdivisions, Five and 10-year appreciation rates are higher in CSDs (Bowman, Thompson, & Colletti, 2009; Mohamed, 2006)
Conservation Subdivisions Development Benefit	**Study Results**
Residents Increased quality of life	Residents in conservation developments experienced a higher level of satisfaction from nearby natural features than residents in conventional developments (Austin, 2004)
Challenges to CSD Implementation	**Study Results**
Regulatory Zoning Codes, No CSD ordinances, and Conservation Easements	Codes do not allow for alternatives. Jurisdictional requirements make the process too burdensome to outweigh benefits. Difficult to generalize process. Complicated reviews discourage applications. (Wenger, S., Fowler, L. 2001) Dealing with third parties and transferring rights can add to complication ("Rethinking property rights," n.d.)

Market Barriers	
Loss of lot size to residents	Proximity to open space does not offset loss of resident lot size (wide variability in 80 subdivisions may have affected the outcome of study) (Kopits, McConnell, & Walls, 2007)
Market demand	Developers may be responding to market demand when considering clustering lots or not (Peiser & Schwann, 1993)
Desire for open space	Public appreciation for open space is difficult to understand (Reichert & Hsin-Yu Liang, 2007)
Private Lands: Lack of Economic Incentive	Tisdell, (2004) found incentives failed to motivate land-owners to conserve land for wildlife habitat.
Lack of affordability	CSD units usually sell at a premium and are usually marketed to higher income classes ("Conservation Subdivisions Demand a Premium," 2013)
Risk Aversion	
Uncertainty, perceived risk, reluctance to new ideas	Risk avoidance is one of the greatest challenges facing CSD (Bosworth, 2007)
Needed Incentives	**Study Results**
Regulations	
Need ordinances for CSDs Having ordinances predict success	Jurisdictions should ensure their current zoning and building codes allow for CSDs to be easily constructed and it is recommended they pass a CSD ordinance that creates a use-by-right of CSDs in residential zoning classes. Passing an ordinance helps to overcome costly delays due to variance requests and exemptions under local zoning ordinances (Allen et. al., 2013; Hall, 2006)
Environmental survey and sketch plans.	Use of site plans and sketch overlays as in Arendt's design model (Arendt, 1999)
Regional Planning is crucial, need for identifying priority linkages required to connect them to a regional network.	Ecological benefit require protection of continuous areas and linking landscapes (Arendt, 2004; Lundgren, 2012; Pejchar et al., 2007)
Federal income tax deductions	
Developers and private landowners should take advantage Federal Tax Code deduction	If land is "qualified conservation contribution" and the Easements to be donated is "exclusively for conservation purposes" the deduction is available. (McLaughlin, 2004) See Section 170 of Federal Tax Code
State income tax credits	
N/A in Texas	Some states pass Conservation tax credit acts such as Georgia that allow 25% of FMV of donated property from state income tax reporting (Carter, 2009)

Conservation Incentives for Private Landowners	(“Wildlife Habitat Benefits Toolkit: Wildlife Habitat Benefits Toolkit: Areas of Decision Support // LandScope America,” n.d.)
Density Developers should understand CSDs are Density Neutral Use density bonuses	CSD have the same lot density as conventional subdivisions and should be emphasized so that developers are aware of this and understand there should be no decrease in revenue stream. There may be a density bonus option which some programs allow. (Arendt, 2004; “ConSubFinal.PDF - Conservation-Subdivision-Ordinances.pdf,” n.d.; Pejchar et al., 2007)
Permitting “Fast-track” -Use of expedited or discretionary review	“Developers also benefit from having an individual either within the jurisdiction or permitting agency who understands the benefits provided by CSD and can articulate these to review authorities who may not be amenable to alternative site designs” (Carter, 2009)
Marketing Differentiate CSDs: Conservation, Added privacy, larger-feeling lots due to adjacency to open-space areas Use of ‘Eco-Brokers’ (www.ecobroker.com) SITES green certification (“Home | SITES,” n.d.) Offer affordable housing	There are other incentives rather than solely based on the conservation aspect (“Conservation-Subdivision-Survey.pdf,” n.d., “River Basin Center | Publications,” n.d.) Smaller developments may seek out brokerage marketing is done externally (Carter, 2009) “Green certification program for CSDs, in general, would allow all CSDs the opportunity to differentiate themselves from the rest of the market” (Carter, 2009) The town of Holden, Maine; Caledonia, Wisconsin; and Bethel, Connecticut requires CSDs to provide different types of housing choices (including affordable housing.(“Breakthroughs: Volume 8 Issue 6 | HUD USER,” n.d.) Others can also be found offering affordable housing choices around the U.S.
Education For developers at local planning offices General public	Education is key when dealing with relative unfamiliarity with the requirements of a CSD. Outreach materials with permit applications, Planning Department webstes, Educational workshops for developers City driven open space plans, statewide conservation efforts, public needs direct connection to information on websites, printed materials after plat to overcome misperceptions about density and care of sensitive ecosystems.(Carter, 2009)

Economics of Conservation Subdivisions, adapted (Carter, 2009).

E. Conservation Subdivision Design Four-Step Process, Arendt



Step One: Delineating greenway land, stormwater, wastewater locations, and potential development

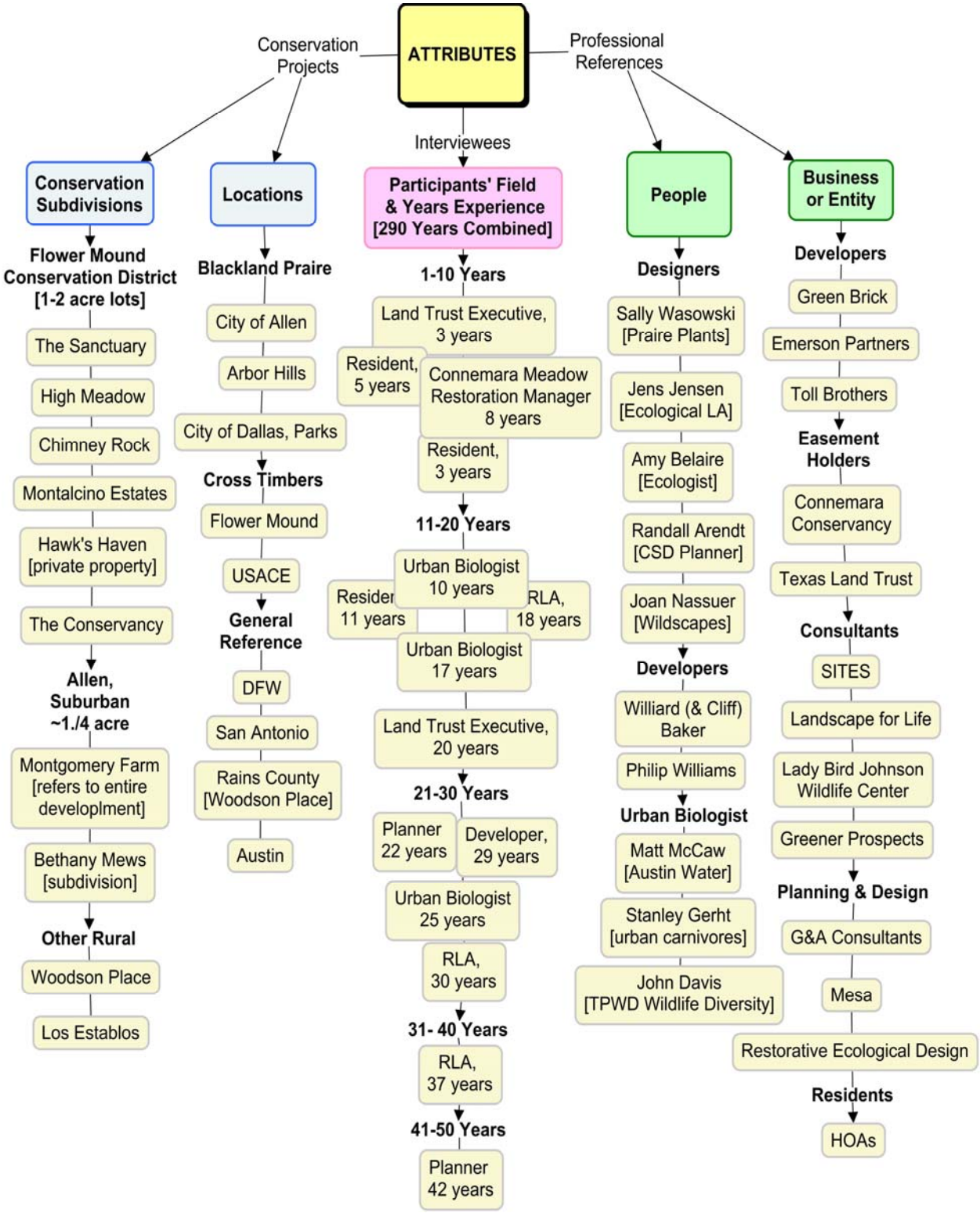
Step Two: Locating house sites

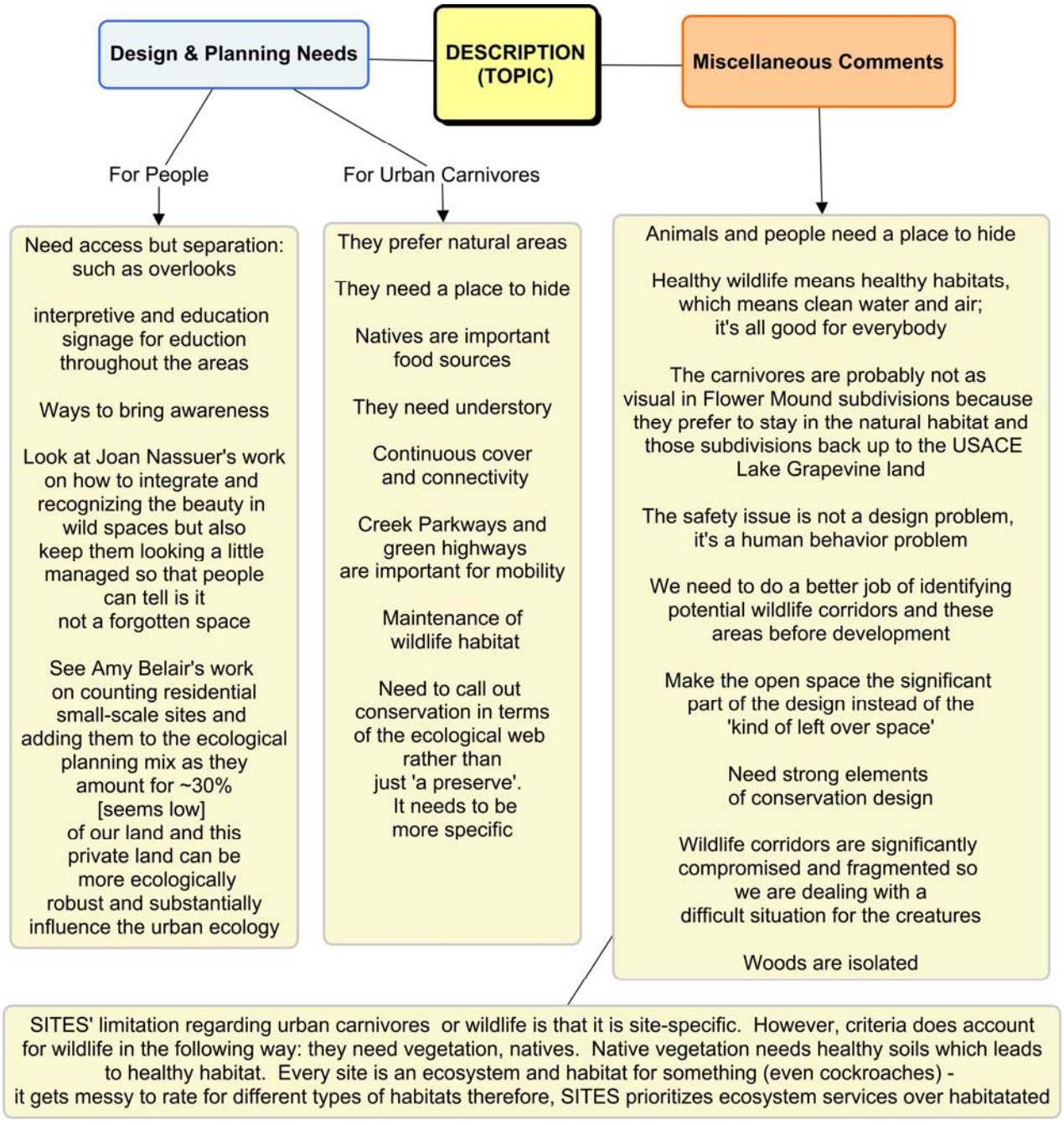
Step Three: Aligning streets and trails

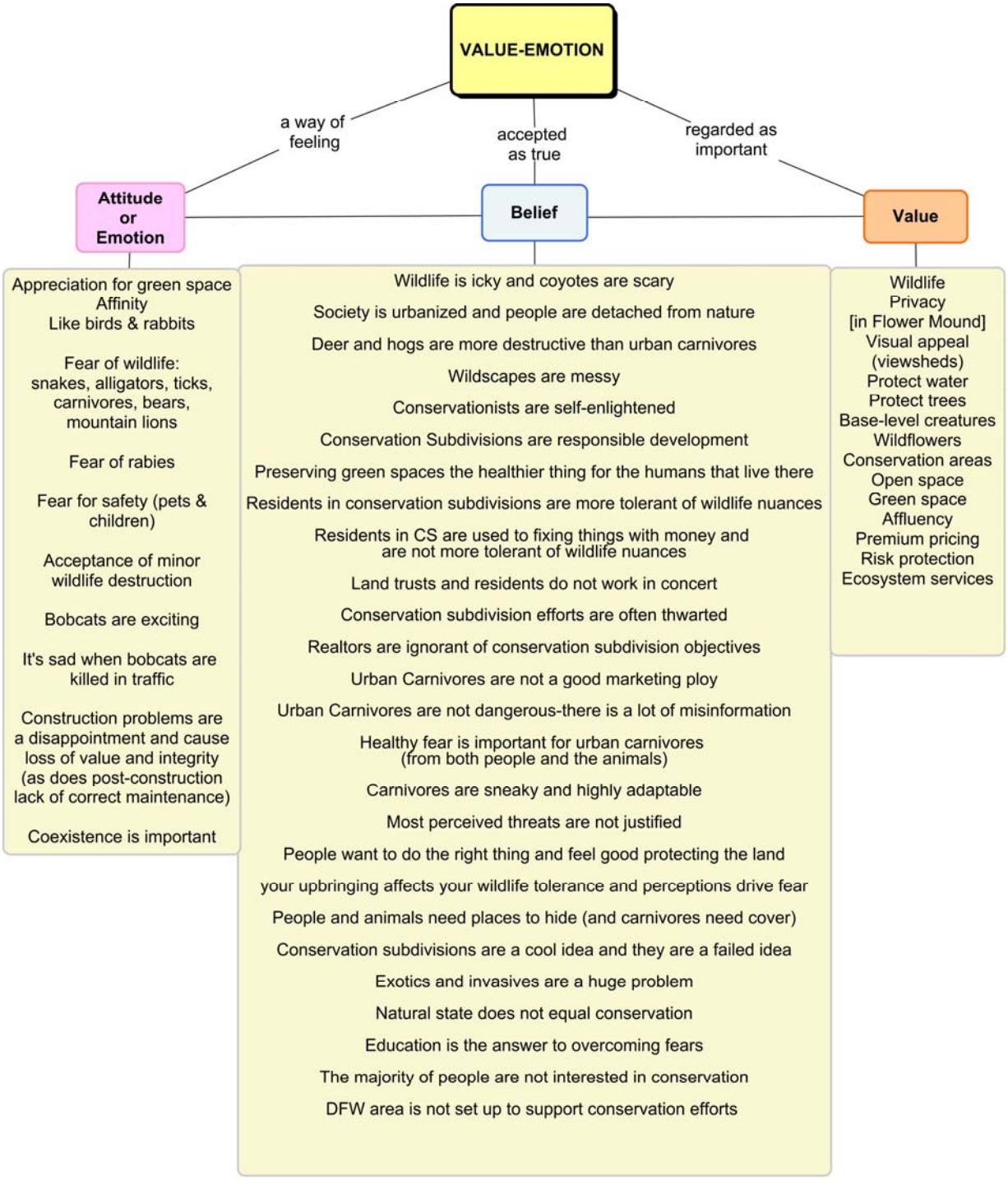
Step Four: Drawing in the lot lines

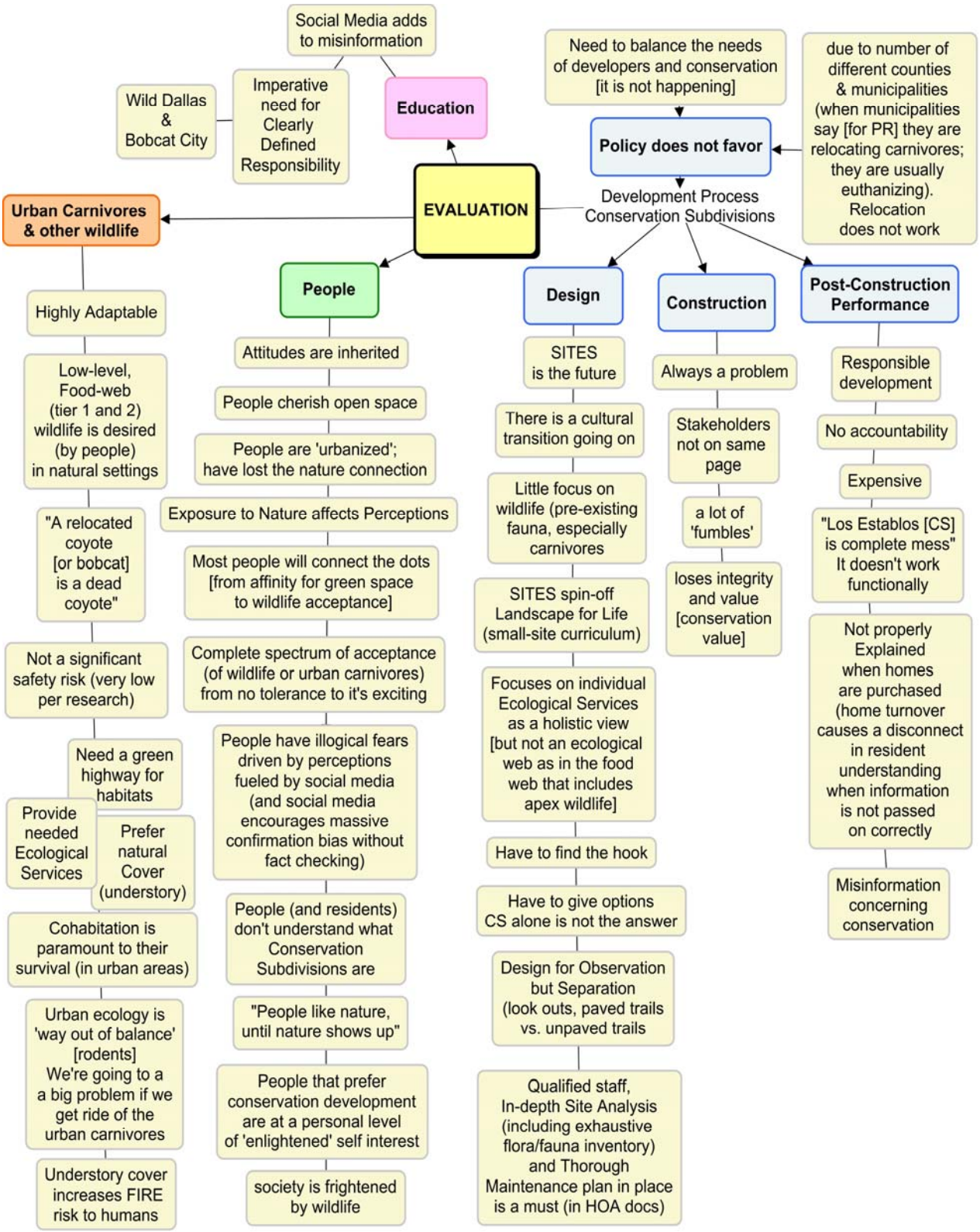
Conservation Subdivision Design, A Four-Step Process,
Source: Growing Greener: Conservation by Design; National Land Trusts (Arendt, 1999)

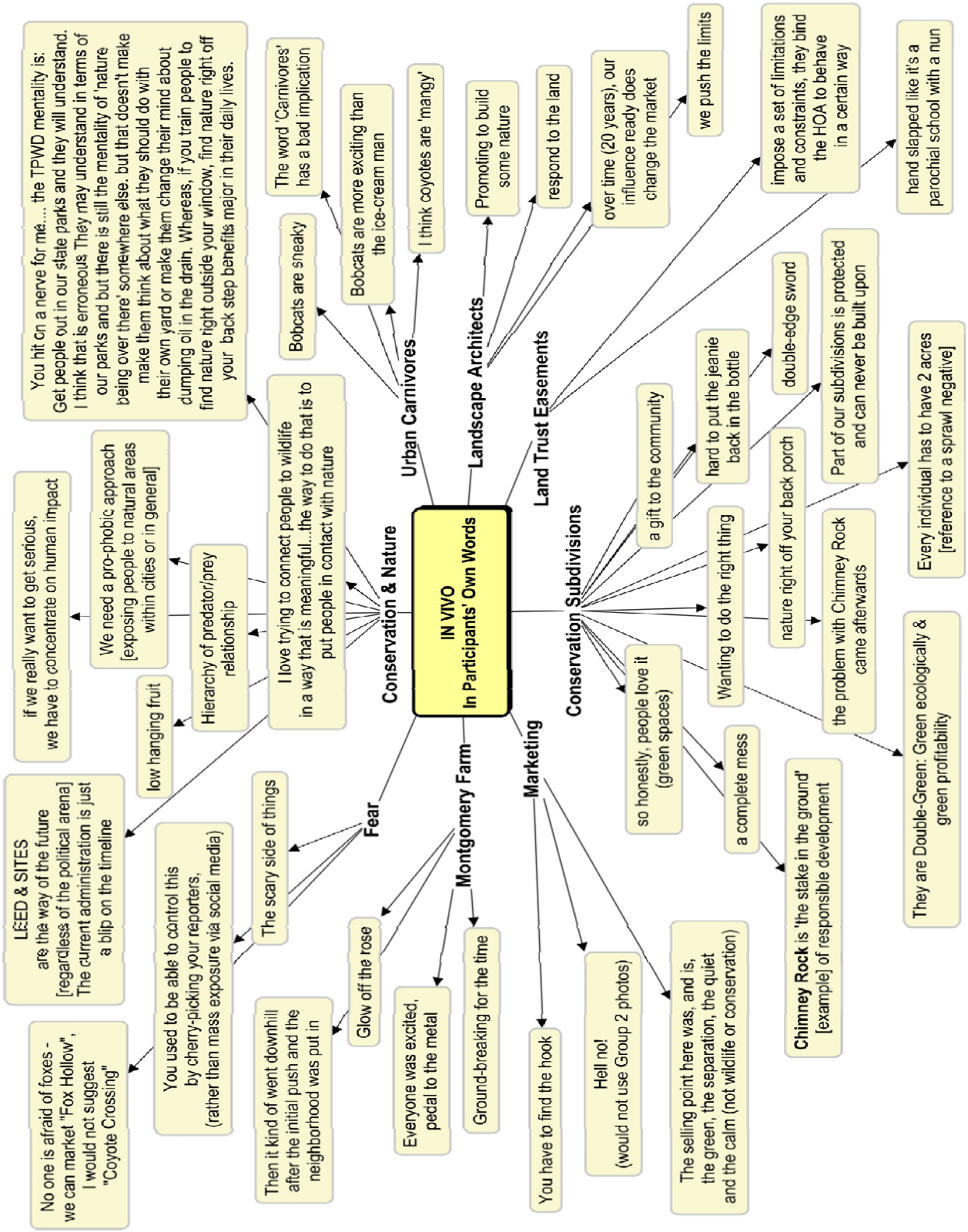
F. Concept Maps

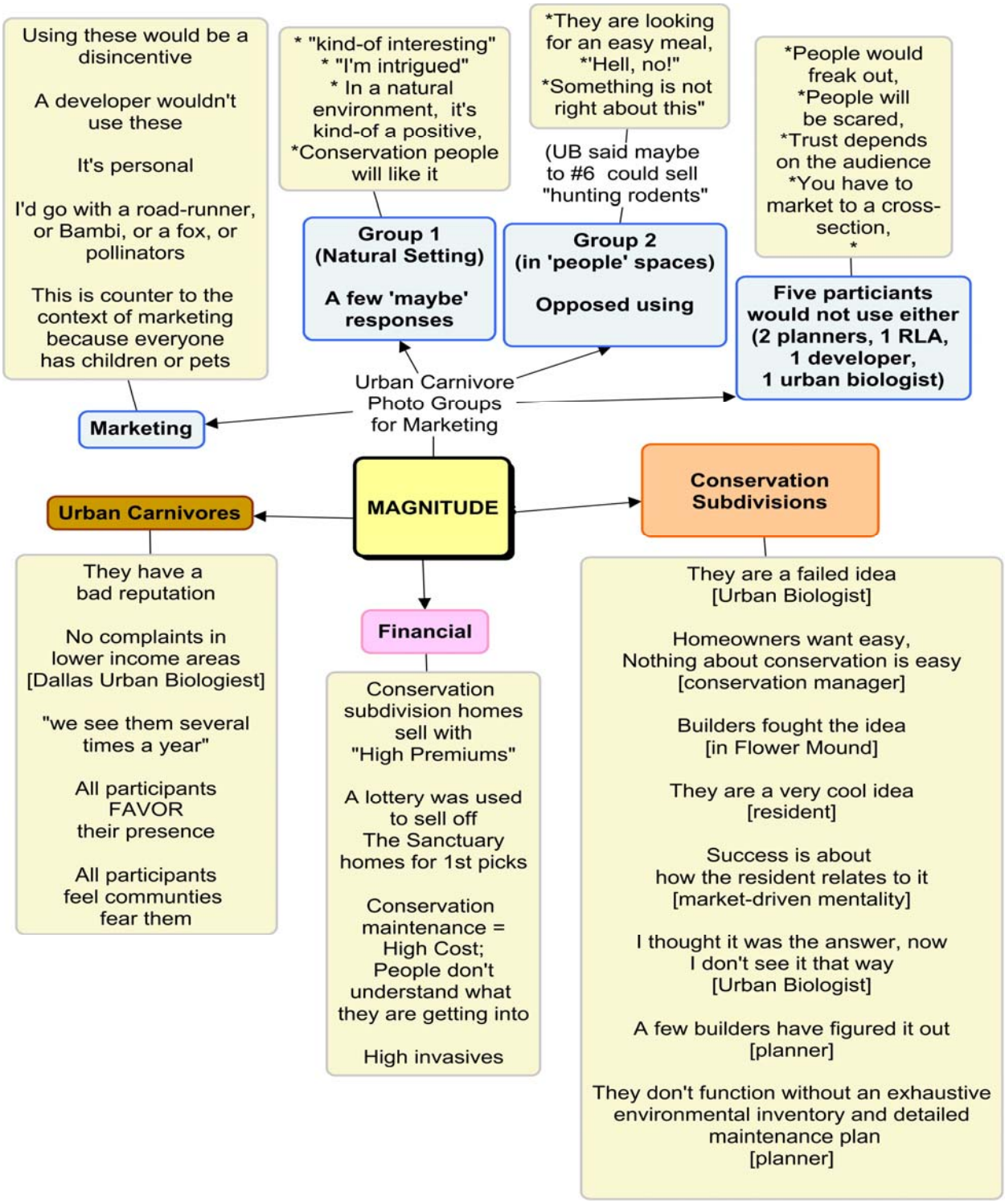


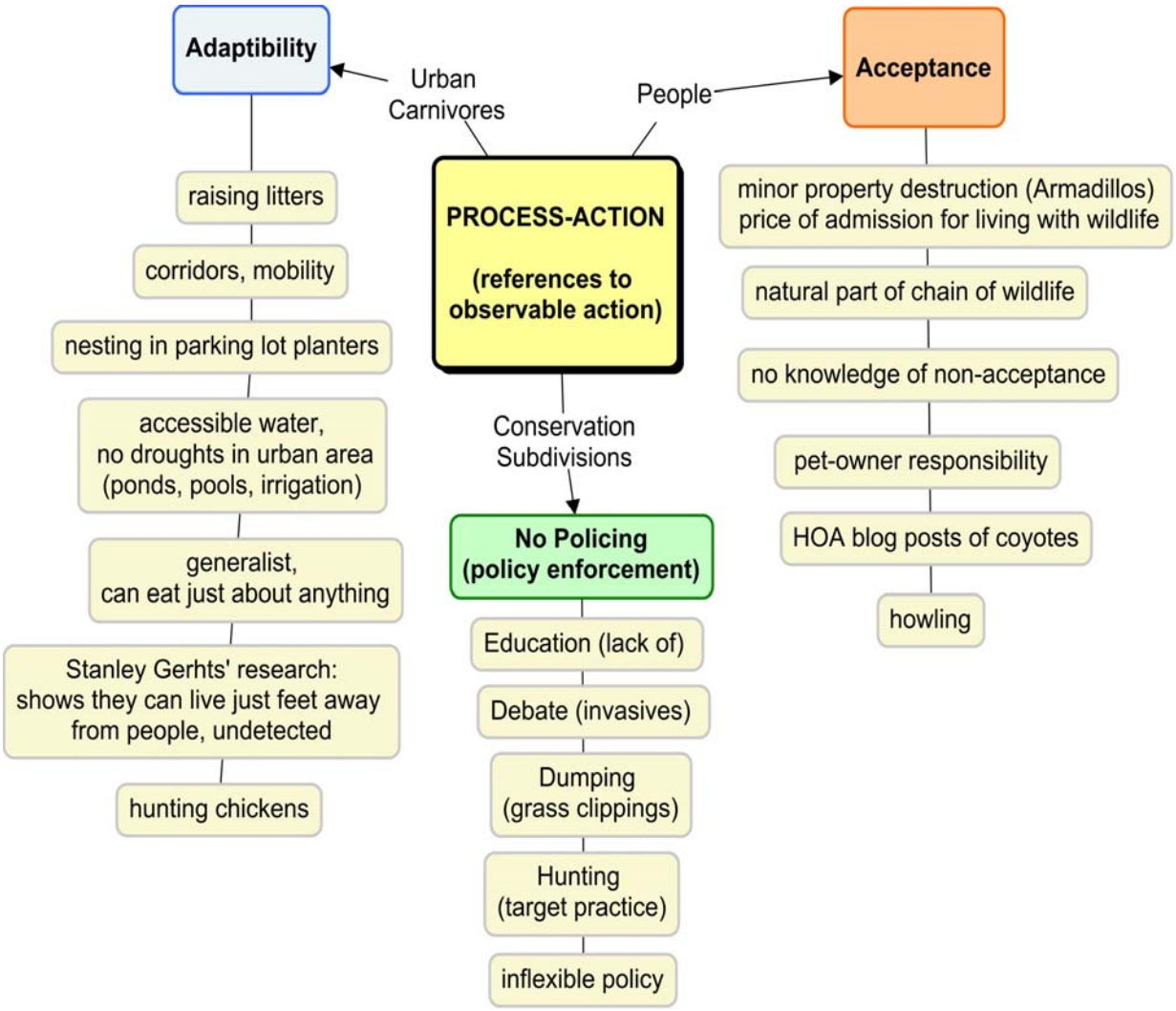

Design & Planning Needs
DESCRIPTION (TOPIC)
Miscellaneous Comments
For People
For Urban Carnivores
Need access but separation: such as overlooks
interpretive and education signage for eduction throughout the areas
Ways to bring awareness
Look at Joan Nassuer's work on how to integrate and recognizing the beauty in wild spaces but also keep them looking a little managed so that people can tell is it not a forgotten space
See Amy Belair's work on counting residential small-scale sites and adding them to the ecological planning mix as they amount for ~30% [seems low] of our land and this private land can be more ecologically robust and substantially influence the urban ecology
They prefer natural areas
They need a place to hide
Natives are important food sources
They need understory
Continuous cover and connectivity
Creek Parkways and green highways are important for mobility
Maintenance of wildlife habitat
Need to call out conservation in terms of the ecological web rather than just 'a preserve'. It needs to be more specific
Animals and people need a place to hide
Healthy wildlife means healthy habitats, which means clean water and air; it's all good for everybody
The carnivores are probably not as visual in Flower Mound subdivisions because they prefer to stay in the natural habitat and those subdivisions back up to the USACE Lake Grapevine land
The safety issue is not a design problem, it's a human behavior problem
We need to do a better job of identifying potential wildlife corridors and these areas before development
Make the open space the significant part of the design instead of the 'kind of left over space'
Need strong elements of conservation design
Wildlife corridors are significantly compromised and fragmented so we are dealing with a difficult situation for the creatures
Woods are isolated
SITES' limitation regarding urban carnivores or wildlife is that it is site-specific. However, criteria does account for wildlife in the following way: they need vegetation, natives. Native vegetation needs healthy soils which leads to healthy habitat. Every site is an ecosystem and habitat for something (even cockroaches) - it gets messy to rate for different types of habitats therefore, SITES prioritizes ecosystem services over habitatated

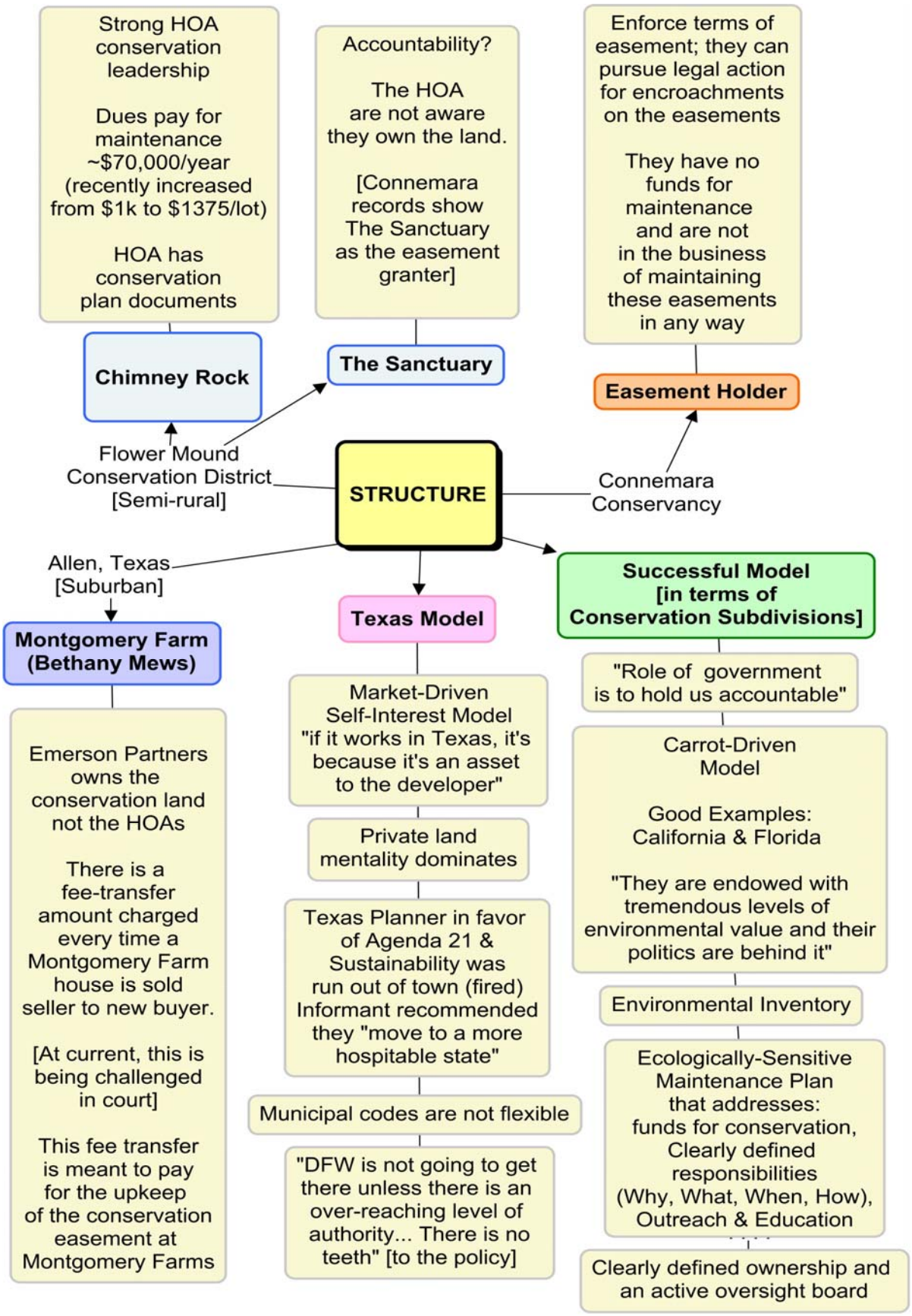

VALUE-EMOTION
a way of feeling
accepted as true
regarded as important
Attitude or Emotion
Belief
Value
Appreciation for green space
Affinity
Like birds & rabbits
Fear of wildlife: snakes, alligators, ticks, carnivores, bears, mountain lions
Fear of rabies
Fear for safety (pets & children)
Acceptance of minor wildlife destruction
Bobcats are exciting
It's sad when bobcats are killed in traffic
Construction problems are a disappointment and cause loss of value and integrity (as does post-construction lack of correct maintenance)
Coexistence is important
Wildlife is icky and coyotes are scary
Society is urbanized and people are detached from nature
Deer and hogs are more destructive than urban carnivores
Wildscapes are messy
Conservationists are self-enlightened
Conservation Subdivisions are responsible development
Preserving green spaces the healthier thing for the humans that live there
Residents in conservation subdivisions are more tolerant of wildlife nuances
Residents in CS are used to fixing things with money and are not more tolerant of wildlife nuances
Land trusts and residents do not work in concert
Conservation subdivision efforts are often thwarted
Realtors are ignorant of conservation subdivision objectives
Urban Carnivores are not a good marketing ploy
Urban Carnivores are not dangerous-there is a lot of misinformation
Healthy fear is important for urban carnivores (from both people and the animals)
Carnivores are sneaky and highly adaptable
Most perceived threats are not justified
People want to do the right thing and feel good protecting the land
your upbringing affects your wildlife tolerance and perceptions drive fear
People and animals need places to hide (and carnivores need cover)
Conservation subdivisions are a cool idea and they are a failed idea
Exotics and invasives are a huge problem
Natural state does not equal conservation
Education is the answer to overcoming fears
The majority of people are not interested in conservation
DFW area is not set up to support conservation efforts
Wildlife
Privacy
[in Flower Mound]
Visual appeal (viewsheds)
Protect water
Protect trees
Base-level creatures
Wildflowers
Conservation areas
Open space
Green space
Affluency
Premium pricing
Risk protection
Ecosystem services

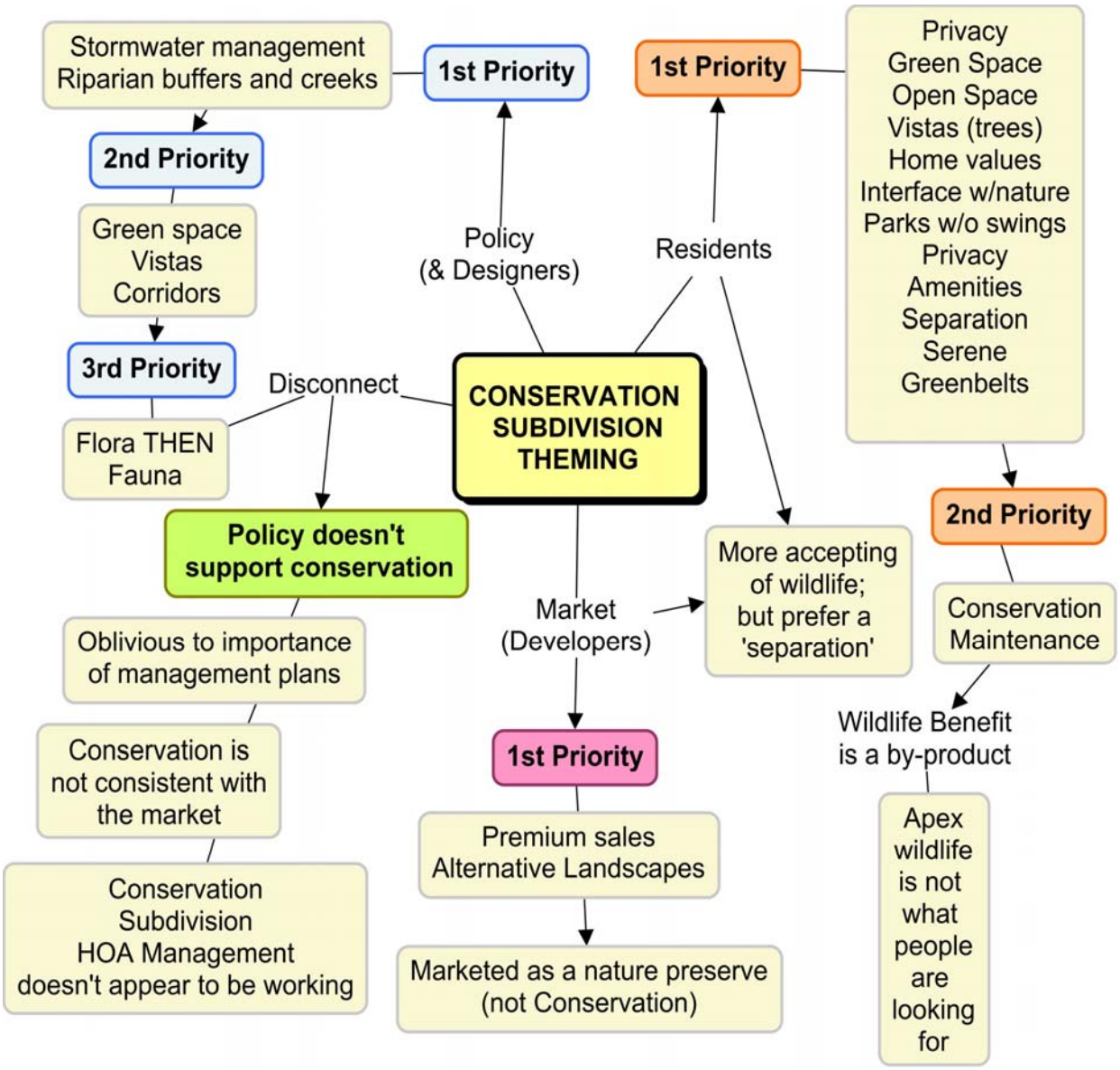

EVALUATION
Education
Social Media adds to misinformation
Imperative need for Clearly Defined Responsibility
Wild Dallas & Bobcat City
Urban Carnivores & other wildlife
Highly Adaptable
Low-level, Food-web (tier 1 and 2) wildlife is desired (by people) in natural settings
"A relocated coyote [or bobcat] is a dead coyote"
Not a significant safety risk (very low per research)
Need a green highway for habitats
Provide needed Ecological Services
Prefer natural Cover (understory)
Cohabitation is paramount to their survival (in urban areas)
Urban ecology is 'way out of balance' [rodents] We're going to a a big problem if we get ride of the urban carnivores
Understory cover increases FIRE risk to humans
People
Attitudes are inherited
People cherish open space
People are 'urbanized'; have lost the nature connection
Exposure to Nature affects Perceptions
Most people will connect the dots [from affinity for green space to wildlife acceptance]
Complete spectrum of acceptance (of wildlife or urban carnivores) from no tolerance to it's exciting
People have illogical fears driven by perceptions fueled by social media (and social media encourages massive confirmation bias without fact checking)
People (and residents) don't understand what Conservation Subdivisions are
"People like nature, until nature shows up"
People that prefer conservation development are at a personal level of 'enlightened' self interest
society is frightened by wildlife
Development Process Conservation Subdivisions
Policy does not favor
Need to balance the needs of developers and conservation [it is not happening]
due to number of different counties & municipalities (when municipalities say [for PR] they are relocating carnivores; they are usually euthanizing). Relocation does not work
Design
SITES is the future
There is a cultural transition going on
Little focus on wildlife (pre-existing fauna, especially carnivores
SITES spin-off Landscape for Life (small-site curriculum)
Focuses on individual Ecological Services as a holistic view [but not an ecological web as in the food web that includes apex wildlife]
Have to find the hook
Have to give options CS alone is not the answer
Design for Observation but Separation (look outs, paved trails vs. unpaved trails
Qualified staff, In-depth Site Analysis (including exhaustive flora/fauna inventory) and Thorough Maintenance plan in place is a must (in HOA docs)
Construction
Always a problem
Stakeholders not on same page
a lot of 'fumbles'
loses integrity and value [conservation value]
Post-Construction Performance
Responsible development
No accountability
Expensive
"Los Establos [CS] is complete mess" It doesn't work functionally
Not properly Explained when homes are purchased (home turnover causes a disconnect in resident understanding when information is not passed on correctly
Misinformation concerning conservation

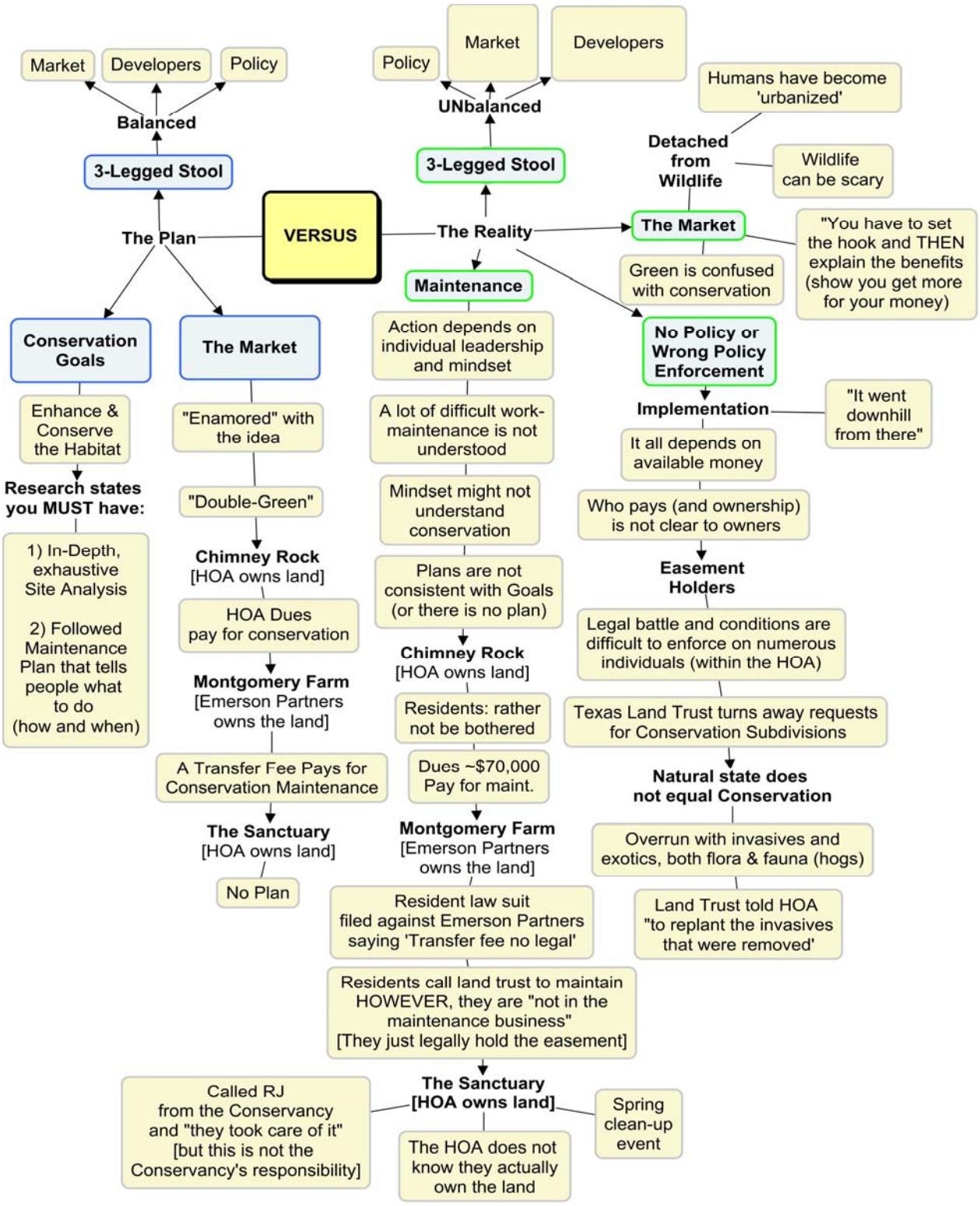

IN VIVO
In Participants' Own Words
Conservation & Nature
Urban Carnivores
Landscape Architects
Land Trust Easements
Conservation Subdivisions
Marketing
Montgomery Farm
Fear
I love trying to connect people to wildlife in a way that is meaningful...the way to do that is to put people in contact with nature
You hit on a nerve for me.... the TPWD mentality is: Get people out in our state parks and they will understand. I think that is erroneous. They may understand in terms of our parks and but there is still the mentality of 'nature being over there' somewhere else. but that doesn't make make them think about what they should do with their own yard or make them change their mind about dumping oil in the drain. Whereas, if you train people to find nature right outside your window, find nature right off your back step benefits major in their daily lives.
The word 'Carnivores' has a bad implication
Bobcats are sneaky
Bobcats are more exciting than the ice-cream man
I think coyotes are 'mangy'
Promoting to build some nature
respond to the land
over time (20 years), our influence ready does change the market
we push the limits
impose a set of limitations and constraints, they bind the HOA to behave in a certain way
hand slapped like it's a parochial school with a nun
Every individual has to have 2 acres [reference to a sprawl negative]
Part of our subdivisions is protected and can never be built upon
double-edge sword
hard to put the jeanie back in the bottle
a gift to the community
Wanting to do the right thing
nature right off your back porch
the problem with Chimney Rock came afterwards
They are Double-Green: Green ecologically & green profitability
so honestly, people love it (green spaces)
a complete mess
Chimney Rock is 'the stake in the ground' [example] of responsible development
The selling point here was, and is, the green, the separation, the quiet and the calm (not wildlife or conservation)
You have to find the hook
Hell no!
(would not use Group 2 photos)
Ground-breaking for the time
Everyone was excited, pedal to the metal
Glow off the rose
Then it kind of went downhill after the initial push and the neighborhood was put in
The scary side of things
You used to be able to control this by cherry-picking your reporters, (rather than mass exposure via social media)
No one is afraid of foxes - we can market "Fox Hollow", I would not suggest "Coyote Crossing"
LEED & SITES are the way of the future [regardless of the political arena] The current administration is just a blip on the timeline
low hanging fruit
Hierarchy of predator/prey relationship
We need a pro-phobic approach [exposing people to natural areas within cities or in general]
if we really want to get serious, we have to concentrate on human impact

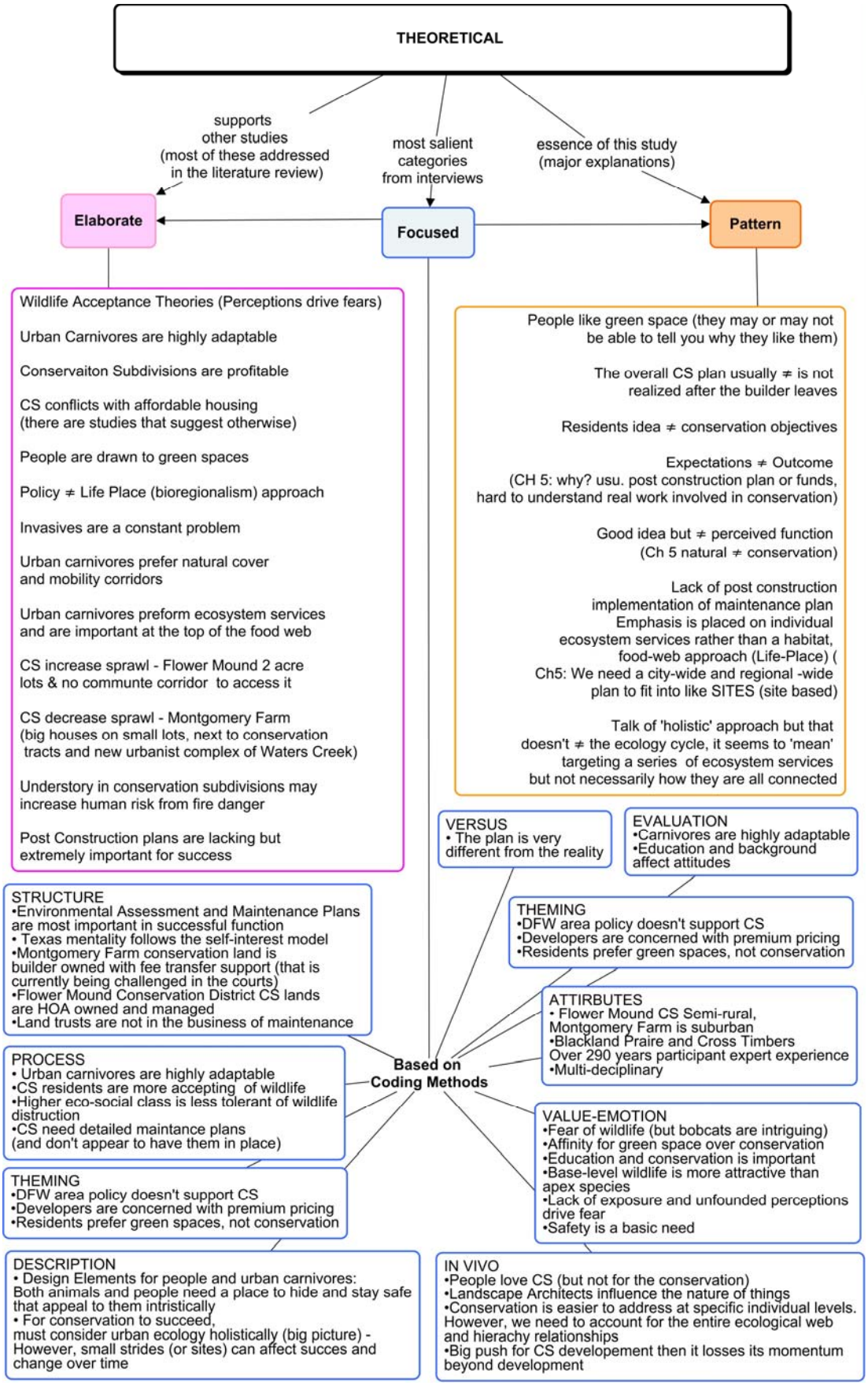

Using these would be a disincentive
A developer wouldn't use these
It's personal
I'd go with a road-runner, or Bambi, or a fox, or pollinators
This is counter to the context of marketing because everyone has children or pets
* "kind-of interesting"
* "I'm intrigued"
* In a natural environment, it's kind-of a positive,
*Conservation people will like it
*They are looking for an easy meal,
*'Hell, no!"
*Something is not right about this"
(UB said maybe to #6 could sell "hunting rodents"
*People would freak out,
*People will be scared,
*Trust depends on the audience
*You have to market to a cross-section,
*
Group 1 (Natural Setting)
A few 'maybe' responses
Group 2 (in 'people' spaces)
Opposed using
Five particiants would not use either (2 planners, 1 RLA, 1 developer, 1 urban biologist)
Urban Carnivore Photo Groups for Marketing
Marketing
MAGNITUDE
Urban Carnivores
Conservation Subdivisions
Financial
They have a bad reputation
No complaints in lower income areas [Dallas Urban Biologiest]
"we see them several times a year"
All participants FAVOR their presence
All participants feel communties fear them
Conservation subdivision homes sell with "High Premiums"
A lottery was used to sell off The Sanctuary homes for 1st picks
Conservation maintenance = High Cost; People don't understand what they are getting into
High invasives
They are a failed idea [Urban Biologist]
Homeowners want easy, Nothing about conservation is easy [conservation manager]
Builders fought the idea [in Flower Mound]
They are a very cool idea [resident]
Success is about how the resident relates to it [market-driven mentality]
I thought it was the answer, now I don't see it that way [Urban Biologist]
A few builders have figured it out [planner]
They don't function without an exhaustive environmental inventory and detailed maintenance plan [planner]


Adaptibility
Urban Carnivores
People
Acceptance
raising litters
corridors, mobility
nesting in parking lot planters
accessible water, no droughts in urban area (ponds, pools, irrigation)
generalist, can eat just about anything
Stanley Gerhts' research: shows they can live just feet away from people, undetected
hunting chickens
PROCESS-ACTION
(references to observable action)
Conservation Subdivisions
No Policing (policy enforcement)
Education (lack of)
Debate (invasives)
Dumping (grass clippings)
Hunting (target practice)
inflexible policy
minor property destruction (Armadillos) price of admission for living with wildlife
natural part of chain of wildlife
no knowledge of non-acceptance
pet-owner responsibility
HOA blog posts of coyotes
howling


Strong HOA conservation leadership
Dues pay for maintenance ~$70,000/year (recently increased from $1k to $1375/lot)
HOA has conservation plan documents
Chimney Rock
Accountability?
The HOA are not aware they own the land.
[Connemara records show The Sanctuary as the easement granter]
The Sanctuary
Enforce terms of easement; they can pursue legal action for encroachments on the easements
They have no funds for maintenance and are not in the business of maintaining these easements in any way
Easement Holder
Flower Mound Conservation District [Semi-rural]
STRUCTURE
Connemara Conservancy
Allen, Texas [Suburban]
Montgomery Farm (Bethany Mews)
Emerson Partners owns the conservation land not the HOAs
There is a fee-transfer amount charged every time a Montgomery Farm house is sold seller to new buyer.
[At current, this is being challenged in court]
This fee transfer is meant to pay for the upkeep of the conservation easement at Montgomery Farms
Texas Model
Market-Driven Self-Interest Model "if it works in Texas, it's because it's an asset to the developer"
Private land mentality dominates
Texas Planner in favor of Agenda 21 & Sustainability was run out of town (fired) Informant recommended they "move to a more hospitable state"
Municipal codes are not flexible
"DFW is not going to get there unless there is an over-reaching level of authority... There is no teeth" [to the policy]
Successful Model [in terms of Conservation Subdivisions]
"Role of government is to hold us accountable"
Carrot-Driven Model
Good Examples: California & Florida
"They are endowed with tremendous levels of environmental value and their politics are behind it"
Environmental Inventory
Ecologically-Sensitive Maintenance Plan that addresses: funds for conservation, Clearly defined responsibilities (Why, What, When, How), Outreach & Education
Clearly defined ownership and an active oversight board


Stormwater management
Riparian buffers and creeks
1st Priority
2nd Priority
Green space
Vistas
Corridors
3rd Priority
Flora THEN
Fauna
Policy
(& Designers)
Residents
1st Priority
Privacy
Green Space
Open Space
Vistas (trees)
Home values
Interface w/nature
Parks w/o swings
Privacy
Amenities
Separation
Serene
Greenbelts
Disconnect
CONSERVATION
SUBDIVISION
THEMING
Policy doesn't
support conservation
Oblivious to importance
of management plans
Conservation is
not consistent with
the market
Conservation
Subdivision
HOA Management
doesn't appear to be working
Market
(Developers)
More accepting
of wildlife;
but prefer a
'separation'
1st Priority
Premium sales
Alternative Landscapes
Marketed as a nature preserve
(not Conservation)
2nd Priority
Conservation
Maintenance
Wildlife Benefit
is a by-product
Apex
wildlife
is not
what
people
are
looking
for


Market
Developers
Policy
Balanced
3-Legged Stool
The Plan
VERSUS
Conservation Goals
Enhance & Conserve the Habitat
Research states you MUST have:
1) In-Depth, exhaustive Site Analysis
2) Followed Maintenance Plan that tells people what to do (how and when)
The Market
"Enamored" with the idea
"Double-Green"
Chimney Rock [HOA owns land]
HOA Dues pay for conservation
Montgomery Farm [Emerson Partners owns the land]
A Transfer Fee Pays for Conservation Maintenance
The Sanctuary [HOA owns land]
No Plan
Policy
Market
Developers
UNbalanced
3-Legged Stool
The Reality
Maintenance
Action depends on individual leadership and mindset
A lot of difficult work-maintenance is not understood
Mindset might not understand conservation
Plans are not consistent with Goals (or there is no plan)
Chimney Rock [HOA owns land]
Residents: rather not be bothered
Dues ~$70,000 Pay for maint.
Montgomery Farm [Emerson Partners owns the land]
Resident law suit filed against Emerson Partners saying 'Transfer fee no legal'
Residents call land trust to maintain HOWEVER, they are "not in the maintenance business" [They just legally hold the easement]
The Sanctuary [HOA owns land]
Called RJ from the Conservancy and "they took care of it" [but this is not the Conservancy's responsibility]
Spring clean-up event
The HOA does not know they actually own the land
Humans have become 'urbanized'
Detached from Wildlife
Wildlife can be scary
The Market
"You have to set the hook and THEN explain the benefits (show you get more for your money)
Green is confused with conservation
No Policy or Wrong Policy Enforcement
Implementation
"It went downhill from there"
It all depends on available money
Who pays (and ownership) is not clear to owners
Easement Holders
Legal battle and conditions are difficult to enforce on numerous individuals (within the HOA)
Texas Land Trust turns away requests for Conservation Subdivisions
Natural state does not equal Conservation
Overrun with invasives and exotics, both flora & fauna (hogs)
Land Trust told HOA "to replant the invasives that were removed'


THEORETICAL
supports other studies (most of these addressed in the literature review)
most salient categories from interviews
essence of this study (major explanations)
Elaborate
Focused
Pattern
Wildlife Acceptance Theories (Perceptions drive fears)
Urban Carnivores are highly adaptable
Conservaiton Subdivisions are profitable
CS conflicts with affordable housing (there are studies that suggest otherwise)
People are drawn to green spaces
Policy ≠ Life Place (bioregionalism) approach
Invasives are a constant problem
Urban carnivores prefer natural cover and mobility corridors
Urban carnivores preform ecosystem services and are important at the top of the food web
CS increase sprawl - Flower Mound 2 acre lots & no commute corridor to access it
CS decrease sprawl - Montgomery Farm (big houses on small lots, next to conservation tracts and new urbanist complex of Waters Creek)
Understory in conservation subdivisions may increase human risk from fire danger
Post Construction plans are lacking but extremely important for success
People like green space (they may or may not be able to tell you why they like them)
The overall CS plan usually ≠ is not realized after the builder leaves
Residents idea ≠ conservation objectives
Expectations ≠ Outcome (CH 5: why? usu. post construction plan or funds, hard to understand real work involved in conservation)
Good idea but ≠ perceived function (Ch 5 natural ≠ conservation)
Lack of post construction implementation of maintenance plan
Emphasis is placed on individual ecosystem services rather than a habitat, food-web approach (Life-Place) (
Ch5: We need a city-wide and regional -wide plan to fit into like SITES (site based)
Talk of 'holistic' approach but that doesn't ≠ the ecology cycle, it seems to 'mean' targeting a series of ecosystem services but not necessarily how they are all connected
VERSUS
• The plan is very different from the reality
EVALUATION
•Carnivores are highly adaptable
•Education and background affect attitudes
STRUCTURE
•Environmental Assessment and Maintenance Plans are most important in successful function
• Texas mentality follows the self-interest model
•Montgomery Farm conservation land is builder owned with fee transfer support (that is currently being challenged in the courts)
•Flower Mound Conservation District CS lands are HOA owned and managed
•Land trusts are not in the business of maintenance
THEMING
•DFW area policy doesn't support CS
•Developers are concerned with premium pricing
•Residents prefer green spaces, not conservation
ATTIRBUTES
• Flower Mound CS Semi-rural, Montgomery Farm is suburban
•Blackland Praire and Cross Timbers
Over 290 years participant expert experience
•Multi-deciplinary
PROCESS
• Urban carnivores are highly adaptable
•CS residents are more accepting of wildlife
•Higher eco-social class is less tolerant of wildlife distruction
•CS need detailed maintance plans (and don't appear to have them in place)
Based on Coding Methods
VALUE-EMOTION
•Fear of wildlife (but bobcats are intriguing)
•Affinity for green space over conservation
•Education and conservation is important
•Base-level wildlife is more attractive than apex species
•Lack of exposure and unfounded perceptions drive fear
•Safety is a basic need
THEMING
•DFW area policy doesn't support CS
•Developers are concerned with premium pricing
•Residents prefer green spaces, not conservation
DESCRIPTION
• Design Elements for people and urban carnivores: Both animals and people need a place to hide and stay safe that appeal to them intristically
• For conservation to succeed, must consider urban ecology holistically (big picture) - However, small strides (or sites) can affect succes and change over time
IN VIVO
•People love CS (but not for the conservation)
•Landscape Architects influence the nature of things
•Conservation is easier to address at specific individual levels. However, we need to account for the entire ecological web and hierachy relationships
•Big push for CS developement then it losses its momentum beyond development

G. Findings Summary Table – Researcher Notes

FINGINGS SUMMARY TABLE	
Theme	**Meaning**
Wide range of professions responding	290-years combined experience in multi-disciplinary fields gives depth to the research
Conservation Subdivisions in NCTx	
Plans ≠ Reality	CS plans ≠ conservation easement objectives
Rural vs. Suburban conservation subdivisions	They are characteristically different
Residents/Buyers desire for CS most often equate to affinity for green spaces	Conservation goals are overlooked
CSD is market-driven rather than policy driven	They sell at premiums, maintenance cost is expensive, & upkeep tends to be a hindrance to conservation efforts
Land Trusts are not in the maintenance business	They do not aid the land owners in conservation efforts
Urban Carnivores in NCTx	
Bobcats are less feared than coyotes	Coyotes are not as well accepted
CS residents are more accepting of wildlife, in general	They tend to be more understanding or willing to tolerate wildlife disturbances in exchange for green space amenities and privacy. They are more likely to be exposed to wildlife as well which affects their wildlife acceptance capacity
People fear wildlife, in general	People fear what they do not understand
There is a lot of misinformation concerning urban carnivores	Urban carnivores are misunderstood & perceived to be unsafe, however, there is research to the contrary
Education and background affect attitudes	Education & exposure affects acceptance
Urban Carnivore Habitat	
Urban carnivores are highly adaptable	CS may affect the presence of urban carnivores insomuch as patch and corridor quality are present
Urban carnivores prefer cover and corridors	natural habitat is important
Design elements for both wildlife and people focused on separation and the idea of nature being 'over there'	Both wildlife and people need places to hide and feel safe, safety is a basic need.
Conservation Subdivisions as Habitat	
There was a negative or 'iffy' response to marketing photos: Bobcats were more acceptable than coyotes and Group 1 was more acceptable than Group 2	Most believe marketing with coyotes would be detrimental to the sales process however, more than 1/2 of the respondents thought using bobcats in natural settings 'might' be ok…..This may indicate perceptions are shifting.
Education as a design element is important	Understanding affects acceptance
Environmental Assessments and Maintenance Plans are most the important aspects of CS function (from a conservation objective point of view) but they are lacking	If conservation goals are to be obtained, these must be present and followed.