THE NON-NATIVE FLORA OF TEXAS

THESIS

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THE NON-NATIVE FLORA OF TEXAS

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CHAPTER I

INTRODUCTION

Texas covers nearly 700,000 sq. km of diverse habitat ranging from deserts in west Texas with 25 cm of precipitation per year to east Texas pine forests with about 140 cm of precipitation per year (Diamond et al. 1987). The large area of Texas creates many different habitats for species to survive. Texas' plant diversity is high in part because it is an east-west transition zone for North American plant species along a strong moisture gradient (MacRoberts and MacRoberts 2003). The state includes parts of two major floristic regions of North America: the North American Atlantic region and the Madrean region. There are 11 natural ecoregions defined by their climate, geology and plant associations, recognized in the state (Diamond et al. 1987).

The estimate of the total flora of the state increased from about 4800 species (Correll and Johnston 1970, Hatch et al. 1990) to about 5100 (Turner et al. 2003, Diggs et al. 2006). This estimate has increased over time due to new native and non-native species being discovered. Texas is second only to California in its number of native species (Stein 2002).

Floras of the state include both native and non-native species. Although most floristic treatments for the state have identified a species as being either native or non-native, until relatively recently there has been no definitive accounting of all the vascular plant species occurring in Texas that are not native to the state. Floras of different regions of Texas have estimated the percentages of non-native species at 17.7 percent in the North Central area (Diggs et al. 1999) and 18.2 percent in East Texas (Diggs et al. 2006). Turner et al. (2003) have given an estimate that 10 percent of the species in Texas are non-native. A publication by the U.S. Geological Survey (Mac et al. 1998) gave an estimate of 696 non-native species. Other publications have documented the occurrence of non-native species in the state but have not contained any comprehensive lists of the species (Cory and Parks 1937, Gould 1962, Gould 1969, Correll and Johnston 1970, Jones et al. 1997, Turner et al. 2003). At the time of this research a parallel research project was completed by Nesom (2009b) listing 812 non-native plant species in Texas.

Terminology

The terminology for referring to non-native plant species can be quite confusing, and many authors have written about the need for clarifying and standardizing the terminology for referring to plant species that are not native to an area (Richardson et al. 2000, Nesom 2000, Pysek et al. 2004). Many terms have been used to describe plant species that are not native to a particular area: exotic, alien, adventive, introduced, non-indigenous and non-native. All of these terms generally refer to species that do not naturally occur in an area except through some human intervention. “Exotic” and “alien” are usually used to refer to introduced plants originating from a different continent. “Adventive” and “introduced” refer to plants that have been deliberately introduced by humans and have escaped and naturalized in the area of introduction. The terms “non-indigenous” and “non-native” have also been used to describe plants that are not native or not naturally occurring in a specific area.

The most general of these terms is non-native and is the term that will be used in this study. Non-native species can be broken down into three categories: cultivated plants, casual aliens, and naturalized plants, with one subcategory of naturalized plants, invasive species, also being recognized. Cultivated plants are deliberately planted, maintained and grown for ornament, consumption, interest or other use. Cultivated plants are frequently not able to reproduce on their own and do not usually pose a threat to surrounding environments.

Casual aliens can be defined as plants that may reproduce occasionally, but do not form self-replacing populations and therefore rely on repeated introductions to persist (Richardson et al. 2000). Many ornamental plants that persist in areas where they were planted, such as old home sites and gardens, are considered casual aliens. Casual aliens do not usually become naturalized, are usually found in small populations, and do not spread far from the parent individuals. Other terms commonly used for plants in this category include “persisting,” “transient,” “waif” or “occasionally escaped.”

Naturalized plant species are those that have been deliberately or accidentally introduced in the past and are now reproducing and maintaining viable populations and dispersing without deliberate human assistance (Nesom 2000, Richardson et al. 2000). Many non-native species become naturalized in unproductive and undisturbed habitats, or in disturbed productive areas, where they may become dominant under productive conditions (Huston 2004). The definition of naturalized plants can also be expanded to include species that are native to a portion of a continental region, but that have expanded their range through human intervention (Nesom 2000).

Invasive plants are naturalized species that produce reproductive offspring, often in very large numbers, at considerable distances from the parent plants and have the potential to spread over a considerable area (Richardson et al. 2000, Pysek et al. 2004). Invasive non-native species are those that grow effectively in certain environments and can drastically change the vegetation of an area. They usually have characteristics such as rapid growth to reproductive maturity, production of a large number of viable seeds, and efficient dispersal mechanisms that allow them to spread quickly and effectively. Invasive plants are the species most often discussed in publications because of their potential negative effects on natural habitats or agriculture. They can be defined as species whose introduction does or is likely to cause environmental or economic harm or harm to human health (Executive Order 13112 1999). Fortunately, the majority of non-native plants are not invasive; therefore many non-native species are left out of invasive plant studies (Mack and Erneberg 2002).

Many non-native plants are able to survive and reproduce but do not have the characteristics that would make them aggressive invaders. More than half of the non-native flora of the United States has resulted from deliberate introductions as food crops or medicinal and ornamental plants (Mack and Erneberg 2002). Species often begin the invasion process as cultivated plants and overcome abiotic and biotic barriers to successful reproduction, causing them to become naturalized (Richardson et al. 2000). The category in which a non-native plant is placed is usually determined by the time since introduction and its stage in the invasion process.

The Invasion Process

Plant species newly introduced into an area have to go through a series of stages to become established and survive. There are three steps in the invasion process: introduction, colonization, and naturalization (Richardson et al. 2000, Radosevich et al. 2003). The invasion process usually begins with introduction by humans. By overcoming biotic and abiotic barriers to establishment, the plants can then spread and possibly have an impact on the environment (Lockwood et al. 2007). With increased human traffic throughout the world made possible by modern means of transportation, large numbers of plant species are being widely dispersed and the number of non-native invasions has been on the increase (McKinney 2001, Chornesky and Randall 2003, Lockwood et al. 2007). Invasion routes can be as ornamentals or food crops, seed contaminants, or as accidental hitchhikers on humans, their vehicles, or construction and maintenance equipment. Repeated introductions of a non-native species can help increase its chances of overcoming the barriers to becoming established (di Castri 1989, Pysek 1998a, Lockwood et al. 2007)

The majority of non-native plants are from some form of cultivation such as landscaping or agriculture (Reichard 1997, Pimentel et al. 2000). Ornamental and crop species are deliberately introduced for their aesthetic value and their importance as food to humans. These plants may become established in areas where they are not native and begin to grow outside of cultivation. Many of these species were sold in seed catalogs before 1900 and deliberate planting may be the origin of many non-native species that have been introduced into the United States (Mack 1991).

Some non-native plants first arrive in a new area as seed contaminants. Such plants often are associated with agricultural or other cultivation practices and grow alongside cultivated plants. When seed from a desirable cultivated species is collected the seeds of unwanted plants may also be collected and can be transported to the same destination as the cultivated seed. The aggressive invasive species, *Salsola kali* ("Russian thistle" or tumbleweed), arrived in the Unites States in 1880 as a contaminant in flax seed from Russia (Mack and Erneberg 2002).

Accidental hitchhikers are plants that can be carried from one area to another directly on clothing or on soil trapped on the bottom of shoes. Plants transported into new areas this way often have adaptations that allow them to be carried long distances by animals. Motor vehicles and construction or maintenance equipment can also transport new plant species into areas, either through seeds trapped in tires or in soil trapped in the wheel wells (Von der Lippe and Kowarik 2007). Highway maintenance equipment, such as mowing machinery, has also been suspected as a vector for transporting non-native species, such as *Orobanche ramosa,* by trapping plant material or seeds in mower blades and depositing them at other sites (White et al. 1998, Lipscomb and Diggs 2005).

Once a species survives introduction, it can then begin colonization of the new area. First, the seed or plant material must have suitable conditions for germinating or growing. Such conditions vary greatly from species to species, but generally include adequate soil, water and sunlight. If it is able to survive the climate and conditions of its new habitat, a new introduction can begin to reproduce successfully and form a self-perpetuating population (Richardson et al. 2000). Plants able to produce reproductive offspring can then spread from the original area of introduction and begin the final step of naturalization into an area.

A species has reached the final stage in the invasion process when it is producing new self-perpetuating populations and undergoing widespread dispersal and beginning to be incorporated into the native flora (Richardson et al. 2000). Many plants fail to reach this stage because the climate, soils, predators and pollinators may be different from their native range. As a consequence, only about 10 percent of non-native plants introduced into an area typically survive to make it through the entire process (Williamson 1996, Cox 1999).

<u>Causes and Impacts of Plant Invasions</u>

An understanding of the kinds and abundance of non-native plants is important for understanding the flora of a region. The presence of non-native plants shows the influence of humans on the environment and native biodiversity. The number of non-native plant species in an area has been shown to be positively correlated with human population and time of settlement in the United States (McKinney 2001). Human influence on the floras of the world has been greater than any other agent during the last 500 years during which the spread of plant species has been more rapid than during any other time period (Fosberg 1958). Humans have been the greatest factor in distributing non-native species throughout the world.

Studies of non-native floras can help our understanding of patterns of plant invasions (Huston 2004, Pysek et al. 2004). A failure to distinguish between native and non-native species in a flora can lead to significant inflation of estimates native biodiversity (Pysek et al. 2004). Non-native species richness is often positively correlated with native species richness (Lonsdale 1999, McKinney 2001, Stohlgren et al. 2001, Stohlgren et al. 2003, Herben et al. 2004, Huston 2004, Pysek et al. 2004), which suggests that conditions that favor high native diversity also favor the establishment of non-natives (Huston 1994, 2004). While many non-native species are common in disturbed and man-made habitats, many of the more aggressive species are invading natural environments.

Impacts of non-native plant species include destruction of wildlife habitat, reduction in opportunities for hunting, fishing, camping and other recreational activities, displacement of threatened and endangered species, reduction of plant and animal diversity, and disruption of waterfowl and migratory bird flight patterns and nesting habitats (Elton 2000, Czech et al. 2000, U.S. BLM 2007). Invasive plant species often have negative effects on the environment and efforts need to be made to understand and control some of these biological threats. Aggressive non-native plants can crowd out native plant species and greatly reduce their numbers which in turn may reduce native forage required by native animals.

Many threatened and endangered plant and animal species are affected by the impacts of non-native species (Cox 1999, Pimentel et al. 2000). Non-native species can greatly affect the native biodiversity of an area by creating monocultures and taking over land used by native species (Chornesky and Randall 2003). It costs billions of dollars in the United States to control non-native plants that impact human activity and the natural environment (Pimentel et al. 2000).

Properties and Origins of Non-native and Invasive Plants

The origin of non-native plants can be important in understanding their life histories and for predicting where they may be best adapted to surviving (Pysek 1998a). Many non-native plants in North America have their origins in Europe or Eurasia. More than 75 percent of the non-native flora of Mexico is known to be native to the Old World (Villaseñor and Espinosa-Garcia 2004). This is thought to be because in the Old World there is a long history of human habitation to which these plants have adapted. Many non-native plants are associated with agricultural practices. North American agricultural practices are modeled after European practices and many European and Eurasian weeds are associated with crops in North America and have invaded other habitats (Heywood 1989, Stuckey and Barkley 1993). Non-native species with origins in Europe are often the most common in floras around the world because of their long history with humans (Weber 1997, di Castri 1989, Heywood 1989, Pysek 1998a, Goodwin et al. 1999). Many non-native plant species successfully made the journey to North America because of the many historic human migrations from Europe.

Non-native species from specific climatic regions in the Old World are often associated with similar climatic regions in North America. Most introduced plants found in the eastern U.S. trace their origins to western and southern Europe whereas most non-native plants in California are from the Mediterranean region and non-native plants found in the intermountain region of the American West are from the mountains of southeastern Europe and southern Asia (di Castri 1989, Stuckey and Barkley 1993, Mac et al. 1998).

The four plant families that have the highest number of species spreading as non-natives throughout the world are the Poaceae, Asteraceae, Fabaceae and Brassicaceae

(Pysek 1998a). These patterns are expected to apply to the non-native flora of Texas as well. Poaceae, Fabaceae and Brassicaceae are three economically important plant families for humans and have a large number of species that have escaped and become naturalized in Texas, as elsewhere (*e.g., Triticum, Sorghum, Medicago, Brassica, Nasturtium*) (Henry and Scott 1981, Pysek 1998a).

The Botanist Effect in Texas

The "botanist effect" is the hypothesis that botanists are most often associated with universities, botanical gardens and herbaria and these institutions are not randomly distributed across the landscape. Much of the field collecting of plants is often done close to these institutions and these areas often show higher species richness because of the more intense collecting. Areas adjacent to these institutions have often been well collected and the flora of these areas may be better represented in collections than areas farther away from such institutions (Delisle et al. 2003, Moerman and Estabrook 2006, Williams and Lutterschmidt 2006). The botanist effect can skew the distribution data of plant species and also increase the species richness of areas close to where botanists collect plants most often.

The purpose of this study is to gather data on the non-native flora of Texas and analyze the distribution of non-native species through the state. The data will be used to determine if the non-native flora of Texas conforms to other patterns throughout the United States along with Mexico. Knowledge of the non-native flora and its distribution can help to understand plant invasions (Pysek 2004) in Texas and potentially protect the natural environment from its effects.

CHAPTER II

METHODS

A preliminary list of vascular plant species not native to Texas that have been collected, reported or known to have been naturalized in the state was developed by using the Checklist of Vascular Plants of Texas (Hatch et al. 1990). Other species were added using various floras and species checklists, such as Cory and Parks (1937), Gould (1962, 1969), Correll and Johnston (1970), Jones et al. (1997), Diggs et al (1999), Turner et al. (2003) and Diggs et al. (2006) in addition to recent journal articles that identify newer introductions and discoveries from the state. Species that were reported from Texas before the end of 2009 are included in this list. Nomenclature followed Jones et al. (1997) or the USDA Plants Database (2009) and other specialized publications (Isley 1998, Barkworth et al. 2007).

Each listed species was researched to identify the earliest voucher specimen to validate its collection in the state. Vouchers were located through herbarium research on the UT Flora of Texas Database (Plant Resources Center 2007) and at the Tracy Herbarium (TAES) to determine when the species was introduced or discovered in the state. Many recent publications listed voucher specimens and this information was included. When a voucher specimen could not be located, checklists and floras (Cory and Parks 1937, Gould 1962, 1969, Correll and Johnston 1970, Hatch et al. 1990, Jones et al. 1997, Nesom 2009b) were used to determine the approximate date of first collection.

The native origins of species were identified using various literature sources (Correll and Johnston 1970, Diggs et al. 1999, Diggs et al. 2006, USDA, NPGS 2009). Plant origins were determined to a continent or a region of a continent. The continents or regions that were used are: Eurasia (encompassing the areas of Europe and Asia), Africa, North America (exclusive of Texas), South America, Oceania (encompassing the Pacific Islands and Australia), Pantropical (found throughout tropical regions of the world), Neotropical (tropical regions of the Americas and Caribbean) and the Mediterranean region. A number of plants had origins from multiple continents and all known areas were recorded. The Mediterranean region was included because the climate of this region is significantly different from that of other regions and the flora is unique.

To evaluate the "botanist effect," Index Herbariorum online (NYBG 2009) was used to select herbaria in Texas that had over 40,000 specimens of plants. These herbaria, along with their herbarium code and county, are: Stephen F. Austin University (ASTC, Nacogdoches County), Baylor University (BAYLU, McLennan County), Botanical Research Institute of Texas (BRIT, Tarrant County), Howard Payne University (HPC, Brown County), Angelo State University (SAT, Tom Green County), Robert A. Vines Environmental Science Center (SBSC, Harris County), Sul Ross State University (SRSC, Brewster County), Texas A&M University (TAMU, Brazos County), Tracy Herbarium (TAES, Brazos County), University of Texas at Austin (TEX, Travis County) and the University of Texas at El Paso (UTEP, El Paso County). Each herbarium was mapped and species data were analyzed to see if the botanist effect affects plant distribution data in Texas by compiling total species diversity for the selected counties and using R (RDCT 2005) to run a multiple regression analysis on the data.

To examine the distribution patterns of non-native species throughout the state, 53 counties were selected in various precipitation zones and ecoregions (Figures 1, 2). Multiple studies have shown that native species richness can predict non-native species richness (Stohlgren et al. 2001, Stohlgren et al. 2003, Jarnevich et al. 2006). Native and non-native plant species lists for each selected county were compiled using the USDA, NRCS Plants Database (2009). These species lists were evaluated to determine which environmental conditions in the counties affect the number of non-native species. County data such as population (USCB 2009), total area, percent cropland, percent farmland (USDA, NASS 2008), precipitation and latitude/longitude were obtained for analysis. Farmland was defined by The Unites States Department of Agriculture as (2009) "any place from which $1,000 or more of agricultural products were, or normally would be, produced and sold during the Census year." This can be important in determining the rate of introduction of non-native species, because there are many non-native plants associated with agricultural practices.

Multiple and linear regression analyses with the statistical software R package (RDCT 2005) were used to find the best predictors of non-native species in the selected counties. A correlation matrix of all of the variables was performed first to identify which variables are highly correlated with each other. The variables that are correlated with each other were analyzed and eliminated from the regression models. The regression models were run with backward elimination. Variables within the multiple regression analyses were identified as significant ($p<0.05$) and then run again as more refined regression models eliminating variables that were not significant (*p* >0.05). The variable of county level data with the best regression model fit determined what best information can be used to predict the number of non-native species in a county. Residual plots were created with the best predictor's residuals and the remaining variables were also used to find if there are any other patterns with these variables. Ecoregions were run in a multiple regression as a dummy variable to assess their significance in determining the number of non-native species ($p<0.05$). These statistical tests were used to identify a good predictor of numbers of non-native species in a county.

Data similar to the selected counties were collected for the United States. These data were analyzed with the same regression models as the county data to identify what predictor best predicts the numbers of non-native species in each state. The results from the county tests were compared to the results of the states data to identify if there were similar patterns in non-native species distribution.

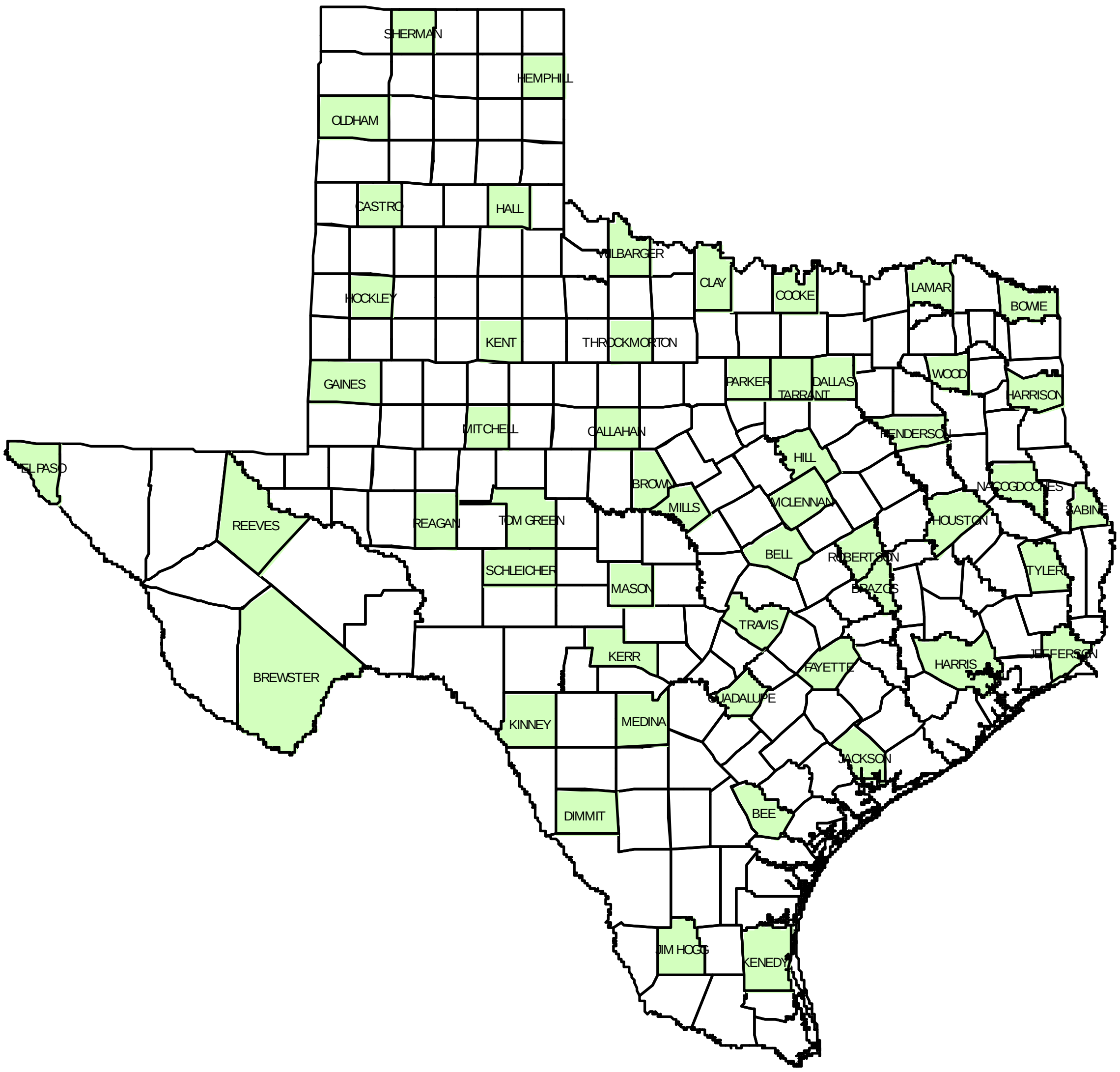
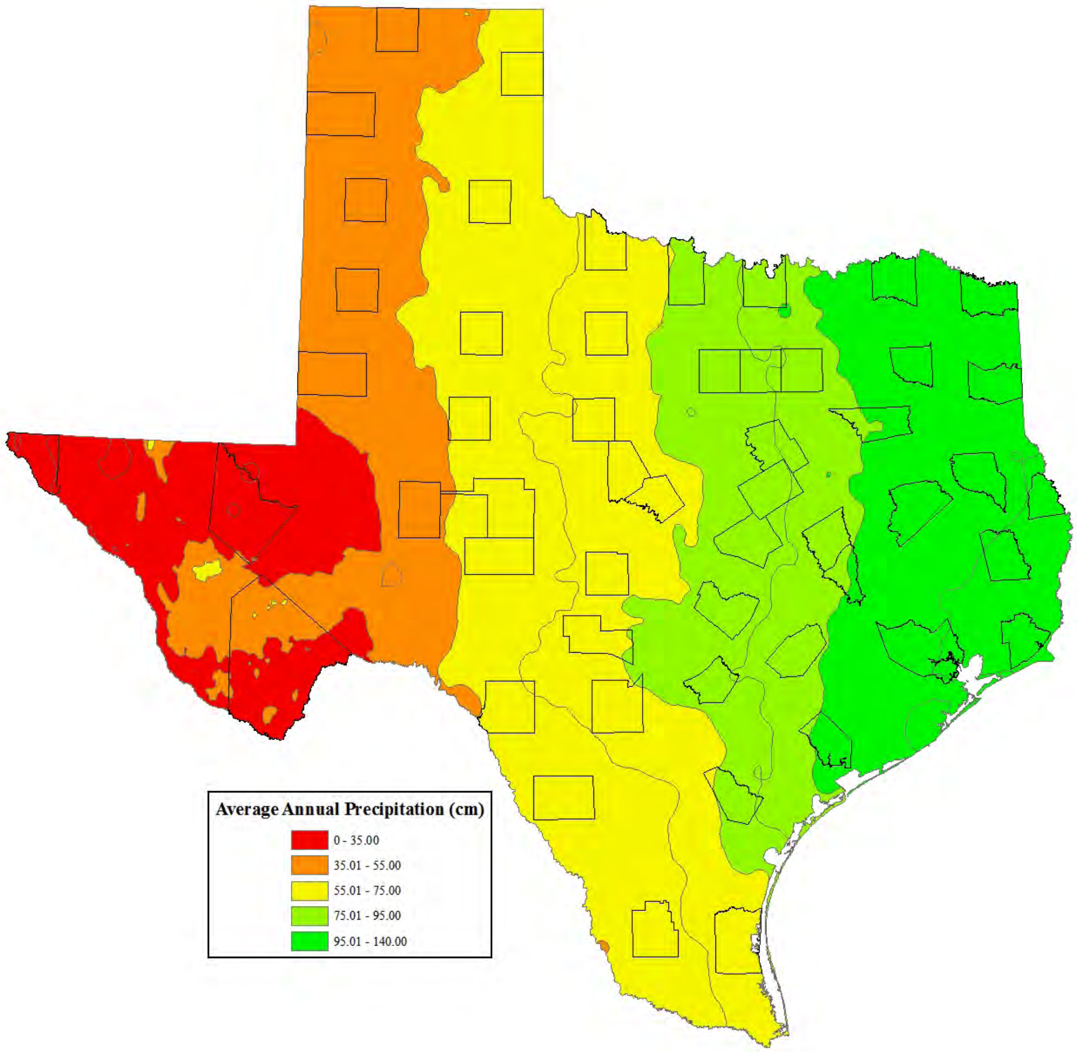
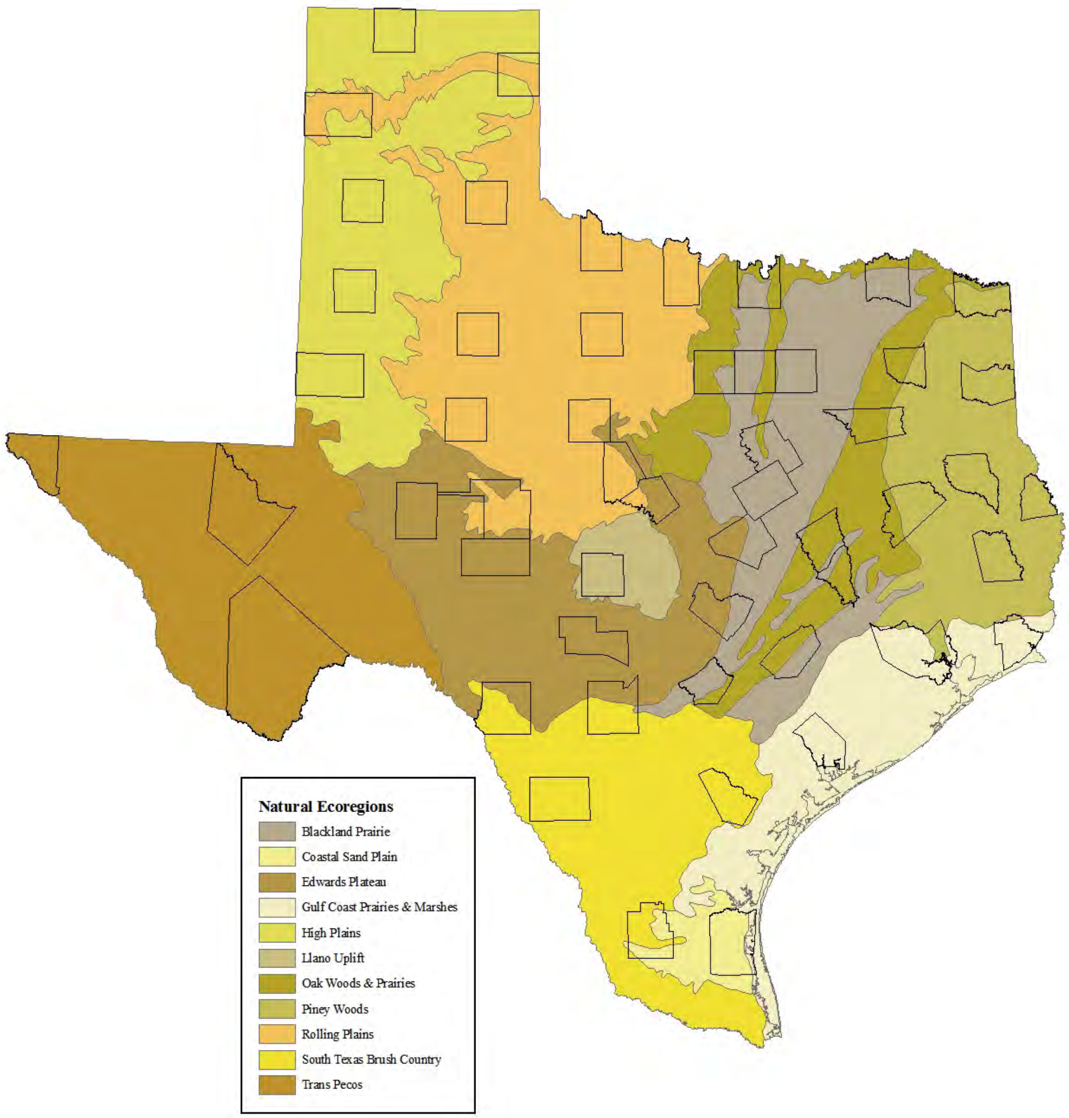


Figure 1 - Selected counties for data analysis.



A.

Figure 2 - Selected counties shown with precipitation gradient (A) and ecoregions (B).



B.

Figure 2 cont. - Selected counties shown with precipitation gradient (A) and ecoregions (B).

CHAPTER III

RESULTS

Synthesis of the Non-native Flora of Texas

There are a total of 817 non-native vascular plant species in Texas (Table 1). The non-native plants make up approximately 15.8 percent of the total flora of Texas. The species are distributed among 104 plant families and 475 genera. This leads to an average of 7.85 species in each family and 1.72 species per genera, but this does not reflect how species are distributed among the families. There are 9 families with more than 20 species, 13 families with 10 – 19 species, 47 families with 2 – 9 species and 35 families with only 1 species. The largest genera, based on number of species, are: *Ipomoea* (Convolvulaceae) – 15, *Bromus* (Poaceae) – 12, *Trifolium* (Fabaceae) – 11 and *Cyperus* (Cyperaceae) – 10. The list in Table 2 provides the accepted scientific name of the non-native species, origin (continent(s) or region(s) where a species is known to be native), reference (earliest known publication attributing the species in the state), voucher (collector's name, collection number and herbarium) and date (date of approximate introduction or first collection in the state).

Table 1 – Summary of the native and non-native flora of Texas.

	Native Species	Non-Native Species	Total	%Non-Native
Pteridophytes	114	10	124	8.1
Gymnosperms	27	1	28	3.6
Dicots	3189	584	3773	15.5
Monocots	1024	222	1246	17.8
Totals:	4354	817	5171	15.8

Table 2 – List of non-native species reported from Texas. Species organized by Division, Class, Family, including origins and references. For species with "–" under "voucher," no voucher was found in this study.

Scientific Name	Origin	Reference	Voucher	Date
PTERIDOPHYTA				
DRYOPTERIDACEAE				
Cyrtomium falcatum C. Presl	Eurasia	Brown and Gandhi 1989	Brown 11999 (SBSC)	1988
LYGODIACEAE				
Lygodium japonicum (Thunb.) Sw.	Eurasia	Gould 1962	Stillwell 109 (TEX)	1937
PARKERIACEAE				
Ceratopteris thalichtroides (L.) Brongn.	Pantropical	Correll and Johnston 1970	Correll 35295 (LL)	1967
POLYPODIACEAE				
Nephrolepis exaltata (L.) Schott	Pantropical	Gould 1962	Parks s.n. (TAES)	1941
PTERIDACEAE				
Cheilanthes notholaenoides (Desv.) Maxon ex Weatherby	Neotropical	Lellinger 1985	—	1985*
Pteris multifida Poir.	Eurasia	Gould 1962	Tharp 44408 (LL)	1944
Pteris vittata L.	Eurasia	Stanford and Diggs 1998	Stanford 5308 (BRIT)	1987
SALVINACEAE				
Salvinia minima Baker	Neotropical	Hatch 1995	Hatch 6403 (TAES)	1993
Salvinia molesta D.Mitch	South America	Jacono 1999	Hatch 7301 (LL)	1999
THELYPTERIDACEAE				
Macrothelypteris torresiana (Gaudich.) Ching	Eurasia, Africa	Correll and Johnston 1970	Rosier s.n. (LL)	1963
PINOPHYTA				
PINACEAE				
Pinus elliottii Engelm.	North America	Correll and Johnston 1970	Correll 32158 (LL)	1966
MAGNOLIOPHYTA				
MAGNOLIOPSIDA				
ACANTHACEAE				
Hygrophila polysperma T. Anders.	Eurasia	Angerstein and Lemke 1994	Tabler s.n. (SWT)	1969
Nomaphila stricta (Vahl) Nees	Eurasia	Ramamorthy and Turner 1992	Turner 16020 (TEX)	1991
Ruellia brittoniana Leonard	Neotropical	Gould 1962	Tharp 2726 (TEX)	1923
Thunbergia alata Bojer ex Sims	Africa	Cory and Parks 1937	Lundell 10770 (LL)	1942
AMARANTHACEAE				
Achyranthes aspera L.	Eurasia	Gould 1969	Correll 27680 (LL)	1963
Alternanthera philoxeroides (Mart.) Griseb.	South America	Cory and Parks 1937	Cory 50843 (TEX)	1945

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
Alternanthera pungens Kunth	South America	Cory and Parks 1937	—	1937*
Alternanthera sessilis (L.) R. Br. ex DC.	Eurasia	Jones et al. 1997	Brown 18040 (TEX)	1994
Alternanthera tenella Colla	South America	Correll and Johnston 1970	—	1970*
Amaranthus blitum L.	Eurasia	Cory and Parks 1937	Runyon 7014 (TEX)	1967
Amaranthus cruentus L.	Neotropical	Correll and Johnston 1970	Smith s.n. (TEX)	1935
Amaranthus hypochondriacus L.	Africa	Gould 1962	Rios 5 (LL)	1965
Amaranthus spinosus L.	Neotropical	Gould 1962	Ball 972 (TEX)	1906
Celosia argentea L.	Africa	Correll and Johnston 1970	—	1970*
Gomphrena globosa L.	Eurasia	Gould 1962	Warnock 64 (TEX)	1939
ANACARDIACEAE				
Pistacia chinensis Bunge	Eurasia	McWilliams 1991	McWilliams M7299030 (TAES)	1990
Schinus molle L.	South America	Gould 1962	Cory 3115 (TAES)	1938
Schinus terebinthifolius Raddi	South America	Lemke 1992	Shiller 973 (TAES)	1941
APIACEAE				
Ammi majus L.	Mediterranean	Cory and Parks 1937	Williams 120 (TEX)	1927
Ammi visnaga (L.) Lam.	Eurasia	Correll and Johnston 1970	Wolff 2956 (TAES)	1931
Anethum graveolens L.	Eurasia	Gould 1962	Runyon 5866 (LL)	1965
Apium graveolens L.	Eurasia	Cory and Parks 1937	Warnock 13303 (LL)	1955
Bupleurum lancifolium Hornem.	Mediterranean	Gould 1969	—	1969*
Bupleurum rotundifolium L.	Mediterranean	Gould 1962	Boaring s.n. (TEX)	1931
Conium maculatum L.	Eurasia	Cory and Parks 1937	Whitehouse 6268 (TEX)	1929
Coriandrum sativum L.	Mediterranean	Cory and Parks 1937	Tracy 307 (TEX)	1902
Cuminum cyminum L.	Mediterranean	Cory and Parks 1937	—	1937*
Cyclospermum leptophyllum (Pers.) Sprague ex Britt. & P. Wilson	Neotropical	Cory and Parks 1937	Tracy 8912 (TEX)	1905
Daucus carota L.	Eurasia	Cory and Parks 1937	Ruth 197 (TEX)	1910
Foeniculum vulgare Mill.	Mediterranean	Cory and Parks 1937	Runyon 222 (TEX)	1930
Hydrocotyle sibthorpioides Lam.	Eurasia	Lipscomb and Diggs 2005	Lipscomb 3502 (BRIT)	2001
Lilaeopsis chinensis (L.) Kuntze	North America	Brown and Marcus 1998	Brown 16926 (TEX)	1993
Pastinaca sativa L.	Eurasia	Cory and Parks 1937	—	1937*
Petroselinum crispum (Mill.) Nyman ex A.W. Hill	Eurasia	Cory and Parks 1937	—	1937*
Scandix pecten-veneris L.	Eurasia	Gould 1962	Brown 5600 (TEX)	1958
Torilis arvensis (Huds.) Link	Mediterranean	Correll and Johnston 1970	Tharp s.n. (TEX)	1935
Torilis japonica (Houtt.) *DC.*	Eurasia	Cory and Parks 1937	Lundell 13835 (TAES)	1945
Torilis nodosa (L.) Gaertn.	Mediterranean	Cory and Parks 1937	Breuer 3092 (TEX)	1910

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
APOCYNACEAE				
Catharanthus roseus (L.) G. Don	Africa	Cory and Parks 1937	Harmel 31 (TAMU)	1964
Nerium oleander L.	Mediterranean	Cory and Parks 1937	Calvesbert 01 (TAMU)	1978
Vinca major L.	Eurasia	Cory and Parks 1937	Gough s.n. (TEX)	1921
Vinca minor L.	Eurasia	Cory and Parks 1937	Parks 8220 (TAES)	1934
ARALIACEAE				
Hedera helix L.	Eurasia, Africa	Correll and Johnston 1970	Tharp s.n. (TAES)	1940
ASCLEPIADACEAE				
Asclepias curassavica L.	South America	Correll and Johnston 1970	Reeves s.n. (TAES)	1941
Cryptostegia grandiflora (Roxb. ex R. Br.) R. Br.	Africa	Patterson and Nesom 2009	Patterson 2009-1 (TEX)	2009
Periploca graeca L.	Eurasia	Correll and Johnston 1970	—	1970*
ASTERACEAE				
Acanthospermum australe (Loefl.) Kuntze	South America	Gould 1962	—	1962*
Acroptilon repens (L.) DC.	Eurasia	Cory and Parks 1937	Cory 33507 (TEX)	1939
Anthemis cotula L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1914
Bidens pilosa L.	South America	Correll and Johnston 1970	Runyon 1444 (TEX)	1932
Carduus acanthoides L.	Eurasia	Jones et al. 1997	Saunders 3418 (TEX)	1992
Carduus nutans L.	Mediterranean	Correll and Johnston 1970	Cory s.n. (TEX)	1940
Carduus pycnocephalus L.	Mediterranean	Dunn 1976	Cory 34528 (LL)	1940
Carthamus lanatus L.	Mediterranean	Gould 1962	Alford s.n. (TAES)	1961
Carthamus tinctorius L.	Mediterranean	Gould 1962	Ness s.n. (TAES)	1896
Centaurea cyanus L.	Mediterranean	Gould 1962	Parks s.n. (TEX)	1947
Centaurea melitensis L.	Eurasia	Cory and Parks 1937	McAllister 1903 (TEX)	1923
Centaurea solstitialis L.	Eurasia	Gould 1962	Flyr s.n. (TEX)	1962
Cichorium intybus L.	Eurasia	Gould 1962	Tharp s.n. (TEX)	1927
Cirsium vulgare (Savi) Ten.	Eurasia	O'Kennon and Nesom 1988	Smith 547 (LL)	1975
Cnicus benedictus L.	Mediterranean	Jones et al. 1997	Landers s.n. (TAES)	1993
Conyza bonariensis (L.) Cronq.	South America	Gould 1962	Boon 27 (TEX)	1942
Cosmos bipinnatus Cav.	Neotropical	Cory and Parks 1937	Brown 14315 (SBSC)	1990
Cosmos sulphureus Cav.	Neotropical	Cory and Parks 1937	Parks s.n. (TEX)	1946
Cotula australis (Sieber ex Spreng.) Hook. f.	Oceania	Correll and Johnston 1970	Johnston s.n. (TEX)	1970
Crepis capillaris (L.) Wallr.	Eurasia	Gould 1962	—	1962*
Crepis pulchra L.	Eurasia	Gould 1962	Shinners 20042 (TEX)	1955
Crepis setosa Haller f.	Eurasia	Hanesworth 1993	Hanesworth s.n. (TEX)	1991
Crepis zacintha (L.) Babcock	Mediterranean	Gandhi and Brown 1993	Brown 15947 (SBSC)	1992
Dimorphotheca sinuata DC.	Africa	Keith 2004a	Keith 94 (BRIT)	2002

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
ASTERACEAE cont.				
Emilia fosbergii D.H. Nicols.	Eurasia	Williams 1994	Williams s.n. (TEX)	1993
Facelis retusa (Lam.) Sch.Bip.	South America	Gould 1962	Tharp 44436 (TEX)	1936
Galinsoga parviflora Cav.	South America	Gould 1962	Young s.n. (TEX)	1918
Gamochaeta antillana (Urb.) Anderb.	South America	Nesom 2004	Tharp 5636 (TEX)	1929
Gamochaeta calviceps (Fern.) Cabrera	South America	Nesom 2004	Shinners 31393 (TEX)	1966
Gamochaeta coarctata (Willd.) Kerg.	South America	Nesom 2004	Correll 37257 (LL)	1969
Gamochaeta pensylvanica (Willd.) Cabrera	South America	Nesom 2004	Young s.n. (TEX)	1915
Hedypnois cretica (L.) Dum.Cours.	Mediterranean	Gould 1962	Palmer 11213 (TEX)	1917
Hypochaeris brasiliensis (Less.) Griseb.	South America	Hatch et al. 1990	—	1990*
Hypochaeris glabra L.	Eurasia	Diggs et al. 1997	Thomas 128683 (TEX)	1992
Hypochaeris microcephala (Sch.Bip.) Cabrera	South America	Gould 1969	Knight 127 (TEX)	1969
Hypochaeris radicata L.	Eurasia	Cory and Parks 1937	Parks s.n. (TAES)	1946
Lactuca saligna L.	Eurasia	O'Kennon et al. 1998b	O'Kennon 14252 (BRIT)	1998
Lactuca serriola L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1915
Lapsana communis L.	Eurasia	O'Kennon et al. 1999	O'Kennon 14377 (BRIT)	1999
Launaea intybacea (Jacq.) Beauv.	South America	Brown and Muschalek 1996	Brown 16813 (SBSC)	1993
Leontodon hispidus L.	Eurasia	Turner et al. 2003	Fleetwood 6 (TEX)	1983
Leontodon taraxacoides (Vill.) Mérat	Eurasia	Vuilleumier 1973	Worthington 22279 (TEX)	1993
Leucanthemum vulgare Lam.	Eurasia	Cory and Parks 1937	—	1937*
Matricaria recutita L.	Eurasia	Cory and Parks 1937	Bogusch 1001 (TEX)	1927
Onopordum acanthium L.	Eurasia	Gould 1962	Blake 31977 (TEX)	1938
Pseudognaphalium luteoalbum (L.) Hilliard & Burtt	Eurasia	Nesom 2001	Carr 7398 (TEX)	1986
Sanvitalia angustifolia A. Gray	Neotropical	Johnston 1990	Henrickson 12444 (TEX)	1978
Scorzonera laciniata L.	Eurasia	Hatch et al. 1990	Higgins 15271 (TEX)	1985
Senecio vulgaris L.	Eurasia	Cory and Parks 1937	Duval 436	1927
Silybum marianum (L.) Gaertn.	Mediterranean	Gould 1962	Parks 31878 (TEX)	1939
Soliva anthemifolia Juss.	South America	Cory and Parks 1937	Reed s.n. (TEX)	1936
Soliva sessilis Ruiz & Pavón	South America	Gould 1962	Stensil s.n. (TEX)	1938
Soliva stolonifera (Brot.) Sweet	South America	Cory and Parks 1937	Tharp s.n. (TEX)	1931
Sonchus asper (L.) Hill	Eurasia	Cory and Parks 1937	Tracy 36 (TEX)	1902
Sonchus oleraceus L.	Eurasia	Cory and Parks 1937	Letterman s.n. (TEX)	1882
Sphagneticola trilobata (L.) Pruski	Pantropical	Brown et al. 2007	Keith 850 (SBSC)	2005
Tagetes erecta L.	Neotropical	Keith 2004b	Keith 701 (SBSC)	2004
Taraxacum laevigatum (Willd.) DC	Eurasia	Gould 1962	Pace s.n. (TEX)	1916
Taraxacum officinale G.H. Weber ex Wiggers	Eurasia	Cory and Parks 1937	Wild Wood Club 14 (TEX)	1931

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
ASTERACEAE cont.				
Tragopogon dubius Scop.	Eurasia	Cory and Parks 1937	Biology Class s.n. (TEX)	1931
Tragopogon porrifolius L.	Eurasia	Gould 1962	Bede s.n. (TEX)	1932
Tridax procumbens L.	Neotropical	Brown and Elsik 2002	Tveten s.n. (SBSC)	2001
Xanthium spinosum L.	South America	Cory and Parks 1937	Winkler 3348 (TEX)	1910
Youngia japonica (L.) DC.	Eurasia	Correll and Johnston 1970	Shinners 29153 (TEX)	1960
Zinnia violacea Cav.	Neotropical	Keith 2004a	Keith 200 (BRIT)	2002
BASELLACEAE				
Anredera cordifolia (Ten.) Steenis	South America	Turner et al. 2003	Nesom 001 (TEX)	1991
BERBERIDACEAE				
Nandina domestica Thunb.	Eurasia	Hatch et al. 1990	Brown 21861 (TAES)	1998
BIGNONIACEAE				
Macfadyena unguis-cati (L.) A.H. Gentry	Neotropical	Hatch et al. 1990	Bauml 74-320A (TAES)	1974
BORAGINACEAE				
Anchusa azurea P. Mill.	Mediterranean	Lemke and Wesby 1989	Wesby s.n. (TEX)	1984
Buglossoides arvensis (L.) I.M. Johnst.	Eurasia	Gould 1962	Devense s.n. (TEX)	1933
Cynoglossum zeylanicum (Hornem.) Thunb. ex Lehm.	Eurasia	Gould 1962	McVaugh 8443 (TEX)	1947
Echium vulgare L.	Eurasia	Cory and Parks 1937	—	1937*
Heliotropium amplexicaule Vahl	South America	Cory and Parks 1937	Tharp s.n. (TEX)	1920
Heliotropium europaeum L.	Eurasia	Cory and Parks 1937	Stanfield s.n. (NY)	1897
Heliotropium indicum L.	Eurasia	Cory and Parks 1937	White 38 (TEX)	1912
Lappula squarrosa (Retz.) Dumort.	Eurasia	Correll and Johnston 1970	—	1970*
BRASSICACEAE				
Arabidopsis thaliana (L.) Heynh.	Eurasia	Gould 1962	Warnock 5831 (TEX)	1947
Armoracia lacustris (A. Gray) Al-Shehbaz & Bates	North America	Brown and Marcus 1998	Correll 23461 (LL)	1960
Brassica juncea (L.) Czern.	Eurasia	Cory and Parks 1937	Heald 4674 (TEX)	1912
Brassica nigra (L.) W.D.J. Koch	Eurasia	Cory and Parks 1937	Cory 317170 (TAES)	1941
Brassica oleracea L.	Eurasia	Gould 1962	Parks 20976 (TAES)	1937
Brassica rapa L.	Eurasia	Cory and Parks 1937	Nelson s.n. (TEX)	1942
Brassica tournefortii Gouan	Eurasia	Lemke and Worthington 1991	Worthington 7993 (TEX)	1982
Cakile maritima Scop.	Eurasia	Rodman 1974	Reverchon s.n. (MO)	1990
Camelina microcarpa Andrz. ex DC.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1918
Camelina rumelica Velen.	Eurasia	McGregor 1984	Shinners 13857 (SMU)	1953
Capsella bursa-pastoris (L.) Medik.	Eurasia	Cory and Parks 1937	Wolf s.n. (TEX)	1909
Cardamine debilis D. Don	Eurasia	Gould 1962	Shinners 29154 (TEX)	1960
Cardamine hirsuta L.	Eurasia	Cory and Parks 1937	Correll 36933 (LL)	1969

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
BRASSICACEAE cont.				
Cardaria draba (L.) Desv.	Eurasia	Correll and Johnston 1970	—	1970*
Chorispora tenella (Pall.) DC.	Eurasia	Lipscomb 1984	Waller 1272 (SMU)	1967
Conringia orientalis (L.) Andrz.	Eurasia	Correll and Johnston 1970	Killian 6985 (TEX)	1926
Coronopus didymus (L.) Sin.	South America	Cory and Parks 1937	Palmer 11986 (TEX)	1917
Descurainia sophia (L.) Webex Prantl	Eurasia	Gould 1962	Runyon 712 (TEX)	1925
Diplotaxis muralis (L.) DC.	Eurasia	Gould 1962	Shinners 9366 (TEX)	1947
Diplotaxis tenuifolia (L.) DC.	Eurasia	Spellenberg et al. 1986	Correll 38588 (LL)	1970
Eruca vesicaria (L.) Cav.	Eurasia	Gould 1962	Hanson s.n. (TEX)	1919
Erucastrum gallicum (Willd.) O.E. Schulz	Eurasia	Gould 1962	Tharp 44028 (TEX)	1929
Erysimum repandum L.	Eurasia	Gould 1962	Russell 35 (TEX)	1923
Lepidium campestre (L.) R. Br.	Eurasia	Brown et al. 2007	Brown 27994 (SBSC)	2003
Lepidium latifolium L.	Eurasia	Worthington 1990	Worthington 3146 (TEX)	1978
Lepidium ruderale L.	Eurasia	Cory and Parks 1937	Runyon 4193 (TEX)	1946
Lobularia maritima (L.) Desv.	Mediterranean	Cory and Parks 1937	—	1937*
Matthiola incana (L.) Ait. f.	Eurasia	Correll and Johnston 1970	Reeves 1873 (TAES)	1942
Matthiola longipetala (Vent.) DC.	Eurasia	Gould 1962	—	1962*
Myagrum perfoliatum L.	Mediterranean	Gould 1962	Shinners 13880 (TEX)	1953
Nasturtium officinale R. Br.	Eurasia	Cory and Parks 1937	Tracy 242 (TEX)	1902
Raphanus raphanistrum L.	Eurasia	Brown and Elsik 2002	Brown 18435 (SBSC)	1995
Raphanus sativus L.	Eurasia	Gould 1962	Reeves 890 (TAES)	1941
Rapistrum rugosum (L.) All.	Mediterranean	Gould 1962	Smith 1070 (TEX)	1948
Sinapis alba L.	Mediterranean	Gould 1962	—	1962*
Sinapis arvensis L.	Eurasia	Gould 1962	Young s.n. (TEX)	1918
Sisymbrium altissimum L.	Eurasia	Gould 1962	Palmer 12013 (TEX)	1917
Sisymbrium irio L.	Eurasia	Cory and Parks 1937	Whitehouse 8301 (TEX)	1932
Sisymbrium officinale (L.) Scop.	Eurasia	Cory and Parks 1937	Tharp 793 (TEX)	1921
Sisymbrium orientale L.	Eurasia	Worthington 1996	Worthington s.n. (TEX)	1980
Sisymbrium polyceratium L.	Eurasia	Correll and Johnston 1970	Warnock 421 (TEX)	1941
Thlaspi arvense L.	Eurasia	Gould 1962	Webster 29 (TEX)	1946
CACTACEAE				
Opuntia ficus-indica (L.) Mill.	Neotropical	Correll and Johnston 1970	Grant 77-12 (TEX)	1977
Pereskia aculeata P. Mill.	South America	Ideker 1996	Ideker ABR11 (BRIT)	1996
CAMPANULACEAE				
Campanula rapunculoides L.	Eurasia	Brown 1985	Brown 7507 (SMU)	1984
Wahlenbergia marginata (Thunb.) A. DC.	Eurasia	Hatch et al. 1990	Watson s.n. (LL)	1971

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
CANNABACEAE				
Cannabis sativa L.	Eurasia	Hatch et al. 1990	Albers s.n. (TEX)	1940
CAPPARACEAE				
Cleome gynandra L.	South America	Cory and Parks 1937	Biology Class 18 (TEX)	1930
Cleome hassleriana Chodat	South America	Cory and Parks 1937	Parks 22311 (TAES)	1937
CAPRIFOLIACEAE				
Lonicera fragrantissima Lindl. & Paxton	Eurasia	Diggs et al. 1999	Traverse 1871 (LL)	1961
Lonicera japonica Thunb.	Eurasia	Cory and Parks 1937	White 50 (TEX)	1912
Lonicera maackii (Rupr.) Maxim.	Eurasia	Diggs et al. 1999	Reeves 1541A (TAES)	1942
CARYOPHYLLACEAE				
Agrostemma githago L.	Eurasia	Cory and Parks 1937	Cheatham s.n. (TEX)	1993
Arenaria serpyllifolia L.	Eurasia	Gould 1962	Smith s.n. (TEX)	1935
Cerastium fontanum Baumg.	Eurasia	Hatch et al. 1990	Tharp s.n. (TEX)	1930
Cerastium glomeratum Thuill.	Eurasia	Gould 1962	Tharp s.n. (TEX)	1921
Cerastium pumilum Curtis	Eurasia	Rabeler and Reznicek 1997	Reznicek 10336 (BRCH)	1997
Dianthus armeria L.	Eurasia	Lipscomb 1984	Ajilvsgi 6938 (SMU)	1977
Dianthus barbatus L.	Eurasia	Hatch et al. 1990	Wisdom 27 (TAES)	1974
Gypsophila elegans Bieb.	Eurasia	Nesom and O'Kennon 2002	Kunselman 23 (TAC)	2001
Holosteum umbellatum L.	Mediterranean	Correll and Johnston 1970	—	1970*
Petrorhagia dubia (Raf.) G. López & Romo	Mediterranean	Rabeler 1985	Correll 35641 (LL)	1968
Polycarpon tetraphyllum (L.) L.	Mediterranean	Gould 1962	Tharp s.n. (TEX)	1931
Sagina procumbens L.	Eurasia	Hulten and Fries 1986	—	1986*
Saponaria officinalis L.	Eurasia	Cory and Parks 1937	LeSueur s.n. (TEX)	1935
Silene conoidea L.	Eurasia	Reed 2004	Loring 03-62 (TAMU)	2003
Silene dichotoma Ehrh.	Eurasia	Cory and Parks 1937	Janne 169 (TAES)	1968
Silene gallica L.	Eurasia	Gould 1962	Warnock T458 (TEX)	1938
Spergula arvensis L.	Eurasia	Cory and Parks 1937	—	1937*
Spergularia echinosperma (Celak.) Aschers. & Graebn.	Eurasia	Gould 1962	Tharp 2890 (TEX)	1924
Spergularia platensis (Cambess.) Fenzl	South America	Cory and Parks 1937	Tharp s.n. (TEX)	1936
Stellaria media (L.) Vill.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1913
Stellaria pallida (Dumort.) Crep.	Eurasia	Rabeler and Reznicek 1997	Reznicek 10361 (BRCH)	1997
Stellaria parva Pedersen	South America	Brown and Marcus 1998	Brown 20104 (SBSC)	1997
Vaccaria hispanica (Mill.) Rauschert	Mediterranean	Gould 1962	Killian s.n. (TEX)	1926
Vaccaria pyramidata Medic.	Eurasia	Gould 1962	—	1962*
CELASTRACEAE				
Euonymus fortunei (Turcz.) Hand.-Mazz.	Eurasia	Nesom 2010a	Nesom 09-01 (TEX)	2009

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
CHENOPODIACEAE				
Atriplex holocarpa F. Mueller	Oceania	Correll and Johnston 1970	—	1970*
Atriplex rosea L.	Eurasia	Cory and Parks 1937	—	1937*
Atriplex semibaccata R. Brown	Oceania	Cory and Parks 1937	Tharp s.n. (TEX)	1919
Bassia hyssopifolia (Pallas) Kuntz	Eurasia	Cory and Parks 1937	Warnock 8800 (LL)	1950
Bassia scoparia (L.) A.J. Scott	Eurasia	Cory and Parks 1937	Parks 1487 (TAES)	1928
Beta vulgaris L.	Eurasia	Correll and Johnston 1970	—	1970*
Chenopodium album L.	Eurasia	Cory and Parks 1937	Hynes s.n. (TEX)	1925
Chenopodium ambrosioides L.	Neotropical	Cory and Parks 1937	Young s.n. (TEX)	1913
Chenopodium botrys L.	Eurasia	Cory and Parks 1937	—	1937*
Chenopodium glaucum L.	Eurasia	Correll and Johnston 1970	Crutchfield 377 (LL)	1965
Chenopodium murale L.	Eurasia, Africa	Cory and Parks 1937	Tharp 1893 (TEX)	1923
Chenopodium opulifolium Schrad.	Eurasia	Gould 1962	—	1962*
Chenopodium pumilio R. Br.	Oceania	Correll and Johnston 1970	Tharp 51-963	1951
Chenopodium vulvaria L.	Eurasia	Correll and Johnston 1970	—	1970*
Salsola collina Pallas	Eurasia	Mosyakin 1996	Worthington 25685.5 (TEX)	1996
Salsola kali L.	Eurasia	Cory and Parks 1937	—	1937*
Salsola tragus L.	Eurasia	Gould 1962	Tharp 529 (TEX)	1921
Spinacia oleracea L.	Eurasia	Correll and Johnston 1970	Reeves 1625 (TAES)	1942
CLUSIACEAE				
Hypercium perforatum L.	Eurasia	Cory and Parks 1937	Lipscomb 3419 (SMU)	1981
COMBRETACEAE				
Conocarpus erectus L.	Neotropical	Turner et al. 2003	—	2003*
Laguncularia racemosa (L.) Gaertn.	Pantropical	Turner et al. 2003	—	2003*
CONVOLVULACEAE				
Convolvulus arvensis L.	Eurasia	Cory and Parks 1937	Reverchon s.n. (TEX)	1902
Ipomoea alba L.	Neotropical	Gould 1962	—	1962*
Ipomoea amnicola Morong	South America	Gould 1962	Runyon 523 (TEX)	1923
Ipomoea batatas (L.) Lam.	Neotropical	Correll and Johnston 1970	—	1970*
Ipomoea cairica (L.) Sweet	Eurasia, Africa	Cory and Parks 1937	Parks 26911 (TAES)	1937*
Ipomoea capillacea (Kunth) G. Don	Neotropical	Gould 1962	Mueller s.n. (TEX)	1931
Ipomoea carnea Jacq.	Neotropical	Gould 1962	Tharp 1191 (TEX)	1922
Ipomoea hederifolia L.	Neotropical	Gould 1962	Tracy 7718 (TEX)	1901
Ipomoea indica (Burm. f.) Merr.	Neotropical	Correll and Johnston 1970	Guajardo 90 (LL)	1965
Ipomoea nil (L.) Roth	South America	Gould 1962	Tharp 541932 (TEX)	1954
Ipomoea quamoclit L.	Neotropical	Cory and Parks 1937	—	1937*

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
CONVOLVULACEAE cont.				
Ipomoea setosa Ker-Gawl.	South America	Hatch et al. 1990	—	1990*
Ipomoea tricolor Cav.	Neotropical	Correll and Johnston 1970	—	1970*
Ipomoea turbinata Lag.	Neotropical	Johnston 1990	—	1990*
Ipomoea violacea L.	Pantropical	Gould 1962	—	1962*
Ipomoea wrightii Gray	Eurasia	Gould 1962	Tharp 44382 (LL)	1938
CRASSULACEAE				
Kalanchoe daigremontiana Raym.-Hamet & H. Perrier	Africa	Everitt et al. 2007	—	2007*
Kalanchoe delagoensis Ecklon & Zeyh.	Africa	Correll and Johnston 1970	Clark 300 (TAES)	1972
Kalanchoe fedtschenkoi Hamet & Perrier	Africa	Turner et al. 2003	—	2003*
CUCURBITACEAE				
Citrullus colocynthis (L.) Schrad.	Eurasia, Africa	Cory and Parks 1937	—	1937*
Citrullus lanatus (Thunb.) Matsum. & Nakai	Africa	Gould 1962	Wolff 46-S (TEX)	1934
Coccinia grandis (L.) Voigt	Eurasia	Correll and Johnston 1970	—	1970*
Cucumis anguria L.	Africa	Cory and Parks 1937	Parks 36633 (TAES)	1940
Cucumis dipsaceus C.G. Ehrenb. ex Spach	Africa	Correll and Johnston 1970	Clover 1897 (TEX)	1934
Cucumis melo L.	Eurasia	Cory and Parks 1937	Gough s.n. (TEX)	1921
Lagenaria siceraria (Molina) Standl.	Africa	Cory and Parks 1937	Parks 10801 (TAES)	1972
Luffa aegyptiaca P. Mill.	Eurasia, Africa	Gould 1962	—	1962*
Momordica balsamina L.	Eurasia, Africa	Cory and Parks 1937	—	1937*
Momordica charantia L.	Eurasia, Africa	Cory and Parks 1937	—	1937*
CUSCUTACEAE				
Cuscuta japonica Choisy	Eurasia	Gonzalez and DallaRosa 2006	—	2006*
Cuscuta suaveolens Ser.	South America	Correll and Johnston 1970	—	1970*
DIPSACACEAE				
Dipsacus fullonum L.	Eurasia	Singhurst and Holmes 2000	Singhurst 9379 (TEX)	2000
Scabiosa atropurpurea L.	Eurasia	Hatch et al. 1990	Reeves 978 (TAES)	1941
ELAEAGNACEAE				
Elaeagnus angustifolia L.	Eurasia	Johnston 1990	Correll 17017 (LL)	1957
Elaeagnus commutata Rydb.	North America	Johnston 1990	—	1990*
Elaeagnus pungens Thunb.	Eurasia	Turner et al. 2003	Williams s.n. (TAES)	1939
EUPHORBIACEAE				
Chamaesyce hirta (L.) Millsp.	South America	Gould 1962	Lipscomb 3113 (SMU)	1980
Croton argenteus L.	Neotropical	Gould 1962	Runyon 515 (TEX)	1923
Euphorbia cyparissias L.	Eurasia	Cory and Parks 1937	—	1937*
Euphorbia graminea Jacq.	South America	Everitt et al. 2007	—	2007*

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
EUPHORBIACEAE cont.				
Euphorbia helioscopia L.	Eurasia, Africa	Cory and Parks 1937	—	1937*
Euphorbia lathyris L.	Eurasia, Africa	O'Kennon 1991b	O'Kennon 6697 (TEX)	1990
Manihot esculenta Crantz	South America	Turner et al. 2003	Johnston 12800 (TEX)	1983
Manihot grahamii Hook.	South America	**	Anderson s.n. (SBSC)	1976
Phyllanthus fraternus G.L. Webster	Eurasia	Brown and Marcus 1998	Brown 18753 (SBSC)	1995
Phyllanthus tenellus Roxb.	Africa	Brown and Gandhi 1989	Brown 14001 (SBSC)	1989
Phyllanthus urinaria L.	Eurasia	Gould 1962	Higginbotham 132 (TAES)	1944
Ricinus communis L.	Africa	Cory and Parks 1937	Ferguson 635 (TEX)	1901
Triadica sebifera (L.) Small	Eurasia	Correll and Johnston 1970	Strandtmann s.n. (LL)	1938
FABACEAE				
Aeschynomene evenia C. Wright	South America	Rudd 1955	Nealley s.n. (MO)	1894
Albizia julibrissin Durazz.	Eurasia	Gould 1962	Smith 300 (TEX)	1946
Albizia lebbeck (L.) Benth.	Eurasia, Oceania	Isely 1998	Cory 54607 (LL)	1948
Alhagi maurorum Medik.	Eurasia	Gould 1962	Warnock 22797 (TEX)	1968
Alysicarpus vaginalis (L.) DC.	Eurasia, Africa	Brown and Marcus 1998	McLeod s.n. (TEX)	1960
Arachis hypogaea L.	South America	Hatch et al. 1990	Taylor 139 (TAES)	1940
Caesalpinia gilliesii (Wallich ex Hook.) Wallich ex D. Dietr.	South America	Cory and Parks 1937	Warnock 10175 (LL)	1911
Caesalpinia mexicana Gray	Neotropical	Cory and Parks 1937	Ness s.n. (TAES)	1926
Caesalpinia pulcherrima (L.) Sw.	Neotropical	Isely 1998	Cory 27181 (TAES)	1935
Canavalia rosea (Sw.) DC.	Pantropical	Hatch et al. 1990	Hildebrand 113 (TEX)	1955
Clitoria ternatea L.	Eurasia	Cory and Parks 1937	Parks 17158 (TAES)	1935
Crotalaria retusa L.	Eurasia	Gould 1962	Strandtmann s.n. (TEX)	1938
Crotalaria spectabilis Roth	Eurasia	Cory and Parks 1937	Johnson 1043 (TEX)	1952
Glycine max (L.) Merr.	Eurasia	Correll and Johnston 1970	Correll 32969 (LL)	1966
Indigofera hirsuta L.	Eurasia, Africa	**.	Aplaca s.n. (SBSC)	2009
Indigofera suffruticosa P. Mill.	Neotropical	Cory and Parks 1937	Riedel s.n. (TEX)	1914
Kummerowia stipulacea (Maxim.) Makino	Eurasia	Gould 1962	Cory 54694 (LL)	1948
Kummerowia striata (Thunb.) Schindl.	Eurasia	Cory and Parks 1937	Reverchon s.n. (TEX)	1900
Lathyrus aphaca L.	Eurasia	Jones and Reznicek 1997	Jones 12913 (ATSC)	1997
Lathyrus hirsutus L.	Mediterranean	Gould 1962	Wagner 80 (TEX)	1944
Lathyrus latifolius L.	Eurasia	Correll and Johnston 1970	—	1970*
Lespedeza bicolor Turcz.	Eurasia	Nesom and Brown 1998	—	1998*
Lespedeza cuneata (Dum.-Cours.) G. Don	Eurasia	Gould 1962	Taylor s.n. (TEX)	1941
Leucaena leucocephala (Lam.) de Wit	Neotropical	Gould 1962	Tharp 46019 (TEX)	1945
Lotus corniculatus L.	Eurasia	Gould 1962	—	1962*

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
FABACEAE cont.				
Medicago arabica (L.) Huds.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1913
Medicago lupulina L.	Eurasia	Cory and Parks 1937	Voigt s.n. (TEX)	1937
Medicago minima (L.) L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1914
Medicago orbicularis (L.) Bartalini	Mediterranean	Gould 1962	Young s.n. (TEX)	1915
Medicago polymorpha L.	Eurasia	Gould 1962	Long s.n. (TEX)	1900
Medicago sativa L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1915
Melilotus albus Medik.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1918
Melilotus indicus (L.) All.	Mediterranean	Cory and Parks 1937	Wolf 811 (TEX)	1909
Melilotus officinalis (L.) Lam.	Eurasia	Cory and Parks 1937	Gough s.n. (TEX)	1921
Neptunia plena (L.) Benth.	Neotropical	Richardson and King 2008	Runyon 1959 (TEX)	1938
Oxyrhynchus volubilis Brandeg.	Neotropical	Gould 1969	—	1969*
Pueraria montana (Lour.) Merr.	Eurasia	Correll and Johnston 1970	McLeod s.n. (TEX)	1960
Robinia hispida L.	North America	Gould 1962	Gentry 51-1313 (TEX)	1950
Robinia pseudoacacia L.	North America	Cory and Parks 1937	White 42 (TEX)	1911
Securigera varia (L.) Lassen	Mediterranean	Lipscomb 1984	Mahler 9677 (SMU)	1983
Senna alata (L.) Roxb.	Neotropical	Correll and Johnston 1970	Warnock 6381 (TEX)	1947
Senna corymbosa (Lam.) Irwin & Barneby	South America	Correll and Johnston 1970	Traverse 886 (LL)	1958
Senna obtusifolia (L.) Irwin & Barneby	Neotropical	Gould 1962	Runyon 673 (TEX)	1924
Senna occidentalis (L.) Link	Neotropical	Cory and Parks 1937	Ferguson 664 (TEX)	1907
Sesbania emerus (Aubl.) Urb.	Neotropical	Turner et al. 2003	Ruth 129 (TEX)	1910
Sesbania punicea (Cav.) Benth.	South America	Gould 1962	Tharp 50-103 (TEX)	1950
Sesbania sericea (Willd.) Link	Eurasia	Cory and Parks 1937	Mears 728 (TEX)	1966
Spartium junceum L.	Eurasia	Worthington 1996	Worthington 19254 (UTEP)	1991
Sphaerophysa salsula (Pallas) DC.	Eurasia	Gould 1962	Cory 45014 (TEX)	1944
Trifolium arvense L.	Eurasia	Gould 1962	Blakely s.n. (TAES)	1963
Trifolium campestre Schreb.	Eurasia	Gould 1962	Cockett 6852 (TEX)	1944
Trifolium dubium Sibthorp	Eurasia	Gould 1962	Reverchon 2657 (TEX)	1907
Trifolium incarnatum L.	Eurasia	Gould 1962	Shinners 13957 (TEX)	1953
Trifolium lappaceum L.	Mediterranean	Brown and Peterson 1984	Brown 4370 (TEX)	1979
Trifolium polymorphum Poir.	North America	Cory and Parks 1937	Tracy 9086 (TEX)	1905
Trifolium pratense L.	Eurasia	Cory and Parks 1937	Tharp 830 (TEX)	1920
Trifolium repens L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1918
Trifolium resupinatum L.	Mediterranean	Gould 1962	Cory 32011 (TEX)	1939
Trifolium subterraneum L.	Eurasia	Gould 1962	McLeod 357 (TAES)	1946
Trifolium vesiculosum Savi	Eurasia	Correll 1972	Correll 38936 (LL)	1970

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
FABACEAE cont.				
Trifolium subterraneum L.	Eurasia	Gould 1962	McLeod 357 (TAES)	1946
Trifolium vesiculosum Savi	Eurasia	Correll 1972	Correll 38936 (LL)	1970
Vicia grandiflora Scop.	Eurasia	Singhurst et al. 2002	Singhurst 10683 (BAYLU)	2001
Vicia hirsuta (L.) S.F. Gray	Eurasia	Flook 1975	Wolff s.n. (SMU)	1944
Vicia lathyroidies L.	Eurasia	Hill et al. 2007	Hill s.n. (BRIT)	2007
Vicia lutea L.	Eurasia, Africa	Neill 1999	Neill 1458 (TAMU)	1998
Vicia sativa L.	Mediterranean	Cory and Parks 1937	Thornton s.n. (TEX)	1934
Vicia tetrasperma (L.) Schreb.	Eurasia	Nixon and Damuth 1987	Nixon 13333 (ATSC)	1984
Vicia villosa Roth	Eurasia	Gould 1962	Killian 6847 (TEX)	1926
Vigna unguiculata (L.) Walp.	Eurasia	Cory and Parks 1937	Turner 3314 (TAES)	1953
Wisteria sinensis (Sims) DC.	Eurasia	Gould 1962	Parker 4810 (TEX)	1912
FUMARIACEAE				
Fumaria densiflora DC.	Eurasia	Reed et al. 2008	Reed 2746 (TAMU)	2004
Fumaria officinalis L.	Eurasia	Cory and Parks 1937	Williams 73 (TEX)	1927
Fumaria parviflora Lam.	Eurasia, Africa	Gould 1962	Friend s.n. (TEX)	1942
GENTIANACEAE				
Centaurium muhlenbergii (Griseb.) Piper	North America	Holmes and Wivagg 1996	Amerson 510 (BRIT)	1971
Centaurium pulchellum (Sw.) Druce	Eurasia	Correll 1972	Fleetwood 9249 (TEX)	1968
GERANIACEAE				
Erodium botrys (Cav.) Bertol.	Eurasia, Africa	Correll and Johnston 1970	Otto 21 (TAES)	1985
Erodium cicutarium (L.) L'Hér. ex Ait.	Mediterranean	Cory and Parks 1937	Tracy 389 (TEX)	1902
Erodium malacoides (L.) L'Hér. ex Ait.	Eurasia, Africa	Lemke and Aplaca 2006	Aplaca 287 (SWT)	2006
Geranium dissectum L.	Eurasia	Correll and Johnston 1970	—	1970*
HALORAGACEAE				
Myriophyllum aquaticum (Vell.) Verdc.	South America	Cory and Parks 1937	York s.n. (TEX)	1939
Myriophyllum spicatum L.	Eurasia, Africa	Correll and Johnston 1970	Correll 25286 (TEX)	1962
LAMIACEAE				
Ajuga reptans L.	Eurasia	Gould 1962	Smith 1179 (TEX)	1948
Glechoma hederacea L.	Eurasia	Turner et al. 2003	—	2003*
Hyptis mutabilis (Rich.) Briq.	Neotropical	Brown and Elsik 2002	Brown 23169 (SBSC)	1999
Lamium amplexicaule L.	Eurasia, Africa	Cory and Parks 1937	Young s.n. (TEX)	1913
Lamium purpureum L.	Eurasia	Correll and Johnston 1970	Shinners 9087 (TEX)	1947
Leonotis nepetifolia (L.) R. Br. ex Ait. f.	Eurasia, Africa	Cory and Parks 1937	York 40 (TEX)	1908
Leonurus cardiaca L.	Eurasia	Cory and Parks 1937	—	1937*
Leonurus sibiricus L.	Eurasia	Correll and Johnston 1970	Correll 34395 (LL)	1967

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
LAMIACEAE cont.				
Marrubium vulgare L.	Eurasia, Africa	Cory and Parks 1937	Ferguson s.n. (TEX)	1901
Mentha x*piperita* L. (pro sp.) [*aquatica* × *spicata*]	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1915
Mentha x*rotundifolia* (L.) Huds. (pro sp.) [*longifolia* × *suaveolens*]	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1913
Mentha spicata L.	Eurasia	Cory and Parks 1937	Tharp s.n. (TEX)	1922
Mentha suaveolens L.	Eurasia	Cory and Parks 1937	—	1937*
Molucella laevis L.	Eurasia	Correll and Johnston 1970	Turner s.n. (TAES)	1954
Nepeta cataria L.	Eurasia	Cory and Parks 1937	Whitehouse s.n. (TEX)	1933
Perilla frutescens (L.) Britt.	Eurasia	Cory and Parks 1937	Tharp s.n. (TEX)	1923
Prunella vulgaris L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1914
Rosmarinus officinalis L.	Mediterranean	Correll and Johnston 1970	Williams s.n. (TAES)	1939
Salvia hispanica L.	Neotropical	Correll and Johnston 1970	—	1970*
Salvia tiliifolia Vahl	Neotropical	Correll and Johnston 1970	Massey (LL)	1964
Scutellaria minor Pers.	South America	Brown 1986b	Ward 1378 (SMU)	1984
Scutellaria racemosa Pers.	South America	Correll and Johnston 1970	Brown 11136 (TEX)	1987
Sideritis lanata L	Eurasia	Correll and Johnston 1970	—	1970*
Stachys floridana Shuttlew.	North America	Nelson 1981	Correll 35815 (LL)	1968
LAURACEAE				
Cinnamomum camphora (L.) J. Presl	Eurasia	Correll and Johnston 1970	Commissioner 207 (TEX)	1940
LINACEAE				
Linum grandiflorum Desf.	Mediterranean	Correll and Johnston 1970	Nesom 5610 (TEX)	1987
Linum usitatissimum L.	Mediterranean	Turner et al. 2003	No Name 414 (TAES)	1891
LOGANIACEAE				
Buddleja lindleyana Fort.	Eurasia	Cory and Parks 1937	Parks 27607 (TAES)	1937
LYTHRACEAE				
Cuphea carthagenensis (Jacq.) J.F. Macbr.	Neotropical	Gould 1962	Correll 31987 (LL)	1965
Cuphea glutinosa Cham. & Schlecht.	South America	Correll and Johnston 1970	Correll 38129 (LL)	1969
Cuphea viscosissima Jacq.	North America	Brown and Elsik 2002	George 43 (SBSC)	1976
Lagerstroemia indica L.	Eurasia	Cory and Parks 1937	Gabriel 3801 (TEX)	1911
Lythrum salicaria L.	Eurasia, Africa	Flook 1975	Watson 540 (SMU)	1971
MAGNOLIACEAE				
Liriodendron tulipifera L.	North America	Correll and Johnston 1970	—	1970*
MALVACEAE				
Abelmoschus esculentus (L.) Moench	Africa	Flook 1975	Wolff 4890 (SMU)	1933
Abutilon theophrasti Medik.	Eurasia	Cory and Parks 1937	Tharp 44480 (TEX)	1936
Alcea rosea L.	Eurasia	Correll and Johnston 1970	—	1970*

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
MALVACEAE cont.				
Gossypium hirsutum L.	Neotropical	Correll and Johnston 1970	Stevenson s.n. (TAES)	1961
Hibiscus syriacus L.	Eurasia	Cory and Parks 1937	White 105 (TEX)	1912
Hibiscus trionum L.	Africa	Cory and Parks 1937	Henderson 63-980 (TEX)	1963
Krapovickasia physaloides (Presl) Fryxell	Neotropical	Brown and Muschalek 1996	Muschalek 10 (SBSC)	1995
Lavatera trimestris L.	Mediterranean	Correll and Johnston 1970	Correll 20975 (TEX)	1959
Malva neglecta Wallr.	Eurasia, Africa	Cory and Parks 1937	Young s.n. (TEX)	1914
Malva parviflora L.	Eurasia, Africa	Cory and Parks 1937	York s.n. (TEX)	1907
Malva pusilla Sm.	Eurasia	Correll and Johnston 1970	—	1970*
Malva rotundifolia L.	Eurasia	Cory and Parks 1937	Ness s.n. (TAES)	1896
Malvastrum coromandelianum (L.) Garcke	Neotropical	Cory and Parks 1937	Lindheimer 682 (TEX)	1850
Malvaviscus penduliflorus DC.	Neotropical	Correll and Johnston 1970	Reeves 359A (TAES)	1941
Pavonia hastata Cav.	South America	Brown et al. 2007	Brown 31921 (SBSC)	2007
MELIACEAE				
Melia azedarach L.	Eurasia	Cory and Parks 1937	Schostag 2976 (TEX)	1910
MENYANTHACEAE				
Nymphoides indica (L.) Kuntze	Neotropical	Saunders 2005	Saunders s.n. (SWT)	2002
Nymphoides peltata (Gmel.) Kuntze	Eurasia	Correll and Johnston 1970	Carr 16583(TEX)	1997
MOLLUGINACEAE				
Glinus lotoides L.	Eurasia, Africa	Cory and Parks 1937	Boon s.n. (TEX)	1934
Mollugo cerviana (L.) Ser.	Eurasia, Africa	Cory and Parks 1937	Hinckley 817 (TEX)	1936
MORACEAE				
Broussonetia papyrifera (L.) L'Hér. ex Vent.	Eurasia	Cory and Parks 1937	Studhalter 4118 (TEX)	1911
Fatoua villosa (Thunb.) Nakai	Eurasia	Lipscomb 1984	Lipscomb 3117 (SMU)	1980
Ficus carica L.	Eurasia	Gould 1962	Waller 2655 (TAES)	1974
Ficus pumila L.	Eurasia	Correll and Johnston 1970	Parks s.n. (TAES)	1946
Morus alba L.	Eurasia	Cory and Parks 1937	Schostag 2974 (TEX)	1910
MYRSINACEAE				
Ardisia crenata Sims	Eurasia	Singhurst et al. 1997	Ledbetter s.n. (BAYLU)	1996
MYRTACEAE				
Myrtus communis L.	Mediterranean	Brown and Elsik 2002	Brown 24588 (SBSC)	2000
NYCTAGINACEAE				
Bougainvillea glabra Choisy	South America	Correll and Johnston 1970	Palmer 36137 (TAES)	1940
Mirabilis jalapa L.	South America	Cory and Parks 1937	Lindheimer 1103 (TEX)	1851
OLEACEAE				
Jasminum mesnyi Hance	Eurasia	Hardin 1974	Flores 77 (TEX)	1963

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
OLEACEAE cont.				
Ligustrum japonicum Thunb.	Eurasia	Nesom 2009a	Carr 26566 (TEX)	2007
Ligustrum lucidum W.T. Aiton	Eurasia	Nesom 2009a	Higginbotham 3025 (TEX)	1910
Ligustrum quihoui Carrière	Eurasia	Correll and Johnston 1970	Shiners 18856 (TEX)	1954
Ligustrum sinense Lour.	Eurasia	Correll and Johnston 1970	Higginbotham 3049 (TEX)	1910
ONAGRACEAE				
Ludwigia erecta (L.) H. Hara	Neotropical	Turner et al. 2003	Jordan s.n. (TEX)	1990
Ludwigia grandiflora (M. Micheli) Greuter & Burdet	South America	Nesom and Kartesz 2000	McMullen s.n. (TEX)	1927
Ludwigia peruviana (L.) Hara	Neotropical	Ramamoorthy and Zardini 1987	—	1987*
Oenothera cordata J.W. Loudon	South America	Correll and Johnston 1970	Duval 165 (TEX)	1921
OROBANCHACEAE				
Orobanche minor Sm.	Eurasia	Brown et al. 2007	Liggio s.n. (SBSC)	2004
Orobanche ramosa L.	Eurasia	White et al. 1998	Johnston s.n. (BAYLU)	1981
OXALIDACEAE				
Oxalis corniculata L.	North America	Correll and Johnston 1970	Tracy 8066 (TEX)	1902
Oxalis debilis Kunth	Neotropical	Correll and Johnston 1970	—	1970*
Oxalis rubra A. St.-Hil.	South America	Gould 1962	Pratt 94 (TAES)	1972
PAPAVERACEAE				
Eschscholzia californica Cham.	North America	Gould 1962	Turner 98-40 (TEX)	1998
Glaucium corniculatum (L.) J.H. Rudolph	Eurasia	Kirkpatrick and Williams 1998	O'Kennon s.n. (TEX)	1993
Papaver rhoeas L.	Mediterranean	Gould 1962	Correll 25839 (LL)	1962
Papaver somniferum L.	Eurasia	Gould 1962	Fryar 30 (LL)	1966
PEDALIACEAE				
Sesamum orientale L.	Eurasia	Manning 1991	—	1991*
PIPERACEAE				
Peperomia pellucida (L.) Kunth	Neotropical	Hatch and Clark 1977	Clark 863A	1973
PLANTAGINACEAE				
Plantago coronopus L.	Eurasia, Africa	O'Kennon et al. 1998a	O'Kennon 14221 (BRIT)	1998
Plantago lanceolata L.	Eurasia	Cory and Parks 1937	Wood s.n. (TEX)	1933
Plantago major L.	Eurasia	Cory and Parks 1937	Whitehouse s.n. (TEX)	1931
POLYGONACEAE				
Antigonon leptopus Hook. & Arn.	Neotropical	Gould 1962	Runyon 5437 (TEX)	1926
Emex spinosa (L.) Campd.	Mediterranean	Gould 1962	Crutchfield 1090 (LL)	1966
Fagopyrum esculentum Moench	Eurasia	O'Kennon et al. 2003	O'Kennon 18432 (BRIT	2003
Polygonum arenastrum Jord. ex Boreau	Eurasia	Correll and Johnston 1970	—	1970*
Polygonum argyrocoleon Steud. ex Kunze	Eurasia	Gould 1962	Cory 44175 (TEX)	1944

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
POLYGONACEAE cont.				
Polygonum aviculare L.	Eurasia	Gould 1962	Young s.n. (TEX)	1914
Polygonum cespitosum Blume	Eurasia	Carr and Hernandez 1993	Crockett 1104 (LL)	1941
Polygonum convolvulus L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1915
Polygonum hydropiper L.	Eurasia	Cory and Parks 1937	—	1937*
Polygonum meisnerianum Cham. & Schltdl.	North America	Correll and Johnston 1970	—	1970*
Polygonum orientale L.	Eurasia	Cory and Parks 1937	Strandtmann s.n. (TEX)	1941
Polygonum persicaria L.	Eurasia	Cory and Parks 1937	Palmer 32061 (TEX)	1926
Rumex acetosella L.	Eurasia	Cory and Parks 1937	Parks 22811 (TAES)	1937
Rumex conglomeratus Murr.	Eurasia, Africa	Correll and Johnston 1970	Berkman 1964 (TEX)	1923
Rumex crispus L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1915
Rumex obtusifolius L.	Eurasia	Cory and Parks 1937	Parks 12857 (TAES)	1935
Rumex paraguayensis Parodi	South America	Brown and Marcus 1998	Neville 274 (SBSC)	1991
Rumex pulcher L.	Eurasia, Africa	Gould 1962	York s.n. (TEX)	1907
PORTULACEAE				
Portulaca grandiflora Hook.	South America	Matthews et al. 1994	Aplaca s.n. (SBSC)	2009
Portulaca oleracea L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1915
PRIMULACEAE				
Anagallis arvensis L.	Eurasia	Correll and Johnston 1970	Young s.n. (TEX)	1914
RANUNCULACEAE				
Adonis annua L.	Eurasia	Gould 1962	Young s.n. (TEX)	1914
Clematis terniflora DC.	Eurasia	Correll and Johnston 1970	Correll 36013 (LL)	1968
Consolida ajacis (L.) Schur	Eurasia, Africa	Cory and Parks 1937	Kurlle s.n. (TAES)	1903
Consolida orientalis (J. Gay) Schroedinger	Eurasia	Correll and Johnston 1970	—	1970*
Ranunculus ficaria L.	Eurasia, Africa	Nesom 2008 B	Nesom FW08-1 (BRIT)	2008
Ranunculus marginatus d'Urv.	Eurasia	Brown 1986a	Brown 7249 (SMU)	1984
Ranunculus muricatus L.	Eurasia, Africa	Cory and Parks 1937	Tharp s.n. (TEX)	1910
Ranunculus parviflorus L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1914
Ranunculus platensis Spreng.	South America	Gould 1962	Shinners 18330 (TEX)	1954
Ranunculus sardous Crantz	Eurasia	Gould 1962	Correll 25188 (LL)	1962
Ranunculus trilobus Desf.	Eurasia	Keener 1979	MacRoberts 982 (LSUS)	1974
RHAMNACEAE				
Hovenia dulcis Thunb.	Eurasia	Goldman 1998	Goldman 1105 (BH)	1997
Paliurus spina-christi P. Mill.	Mediterranean	O'Kennon 1991a	O'Kennon 2766 (BRIT)	1988
Sageretia thea (Osbeck) M.C. Johnston	Eurasia, Africa	Brown and Gandhi 1989	Brown 12200 (SBSC)	1988
Ziziphus zizyphus (L.) Karst.	Eurasia	Gould 1962	Young s.n. (TEX)	1914

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
ROSACEAE				
Aphanes microcarpa (Boiss. & Reut.) Rothm.	Eurasia	Gould 1962	Shinners 22959 (TEX)	1956
Duchesnea indica (Andr.) Focke	Eurasia	Gould 1962	Young s.n. (TEX)	1916
Photinia serratifolia (Desf.) Kalkm.	Eurasia	Nesom 2008	Nesom FW08-03 (TEX)	2008
Potentilla recta L.	Eurasia	Gould 1962	Correll 35753 (LL)	1968
Prunus persica (L.) Batsch	Eurasia	Cory and Parks 1937	McCart 8957 (TEX)	1958
Pyracantha coccinea M. Roemer	Eurasia	Turner et al. 2003	Fuller 20 (TAES)	1965
Pyracantha fortuneana (Maxim.) H.L. Li	Eurasia	Nesom 2010b	White 10 (SMU)	1971
Pyracantha koidzumii (Hayata) Rehder	Eurasia	Nesom 2010b	Kral 68559 (VDB)	1982
Pyrus calleryana Dcne.	Eurasia	Turner et al. 2003	—	2003*
Pyrus communis L.	Eurasia	Cory and Parks 1937	Abrigo s.n. (TEX)	1963
Rosa bracteata J.C. Wendl.	Eurasia	Cory and Parks 1937	Lewton 759 (LL)	1909
Rosa eglanteria L.	Eurasia	Cory and Parks 1937	—	1937*
Rosa laevigata Michx.	Eurasia	Cory and Parks 1937	School 5740 (TEX)	1929
Rosa micrantha Borrer ex Sm.	Eurasia	Cory and Parks 1937	—	1937*
Rosa multiflora Thunb. ex Murr.	Eurasia	Gould 1962	Traverse 1962 (LL)	1961
Rosa tomentosa Sm.	Eurasia	Cory and Parks 1937	—	1937*
Rubus bifrons Vest ex Tratt.	Eurasia	Gould 1962	McVaugh 6971 (TEX)	1945
RUBIACEAE				
Asperula arvensis L.	Eurasia, Africa	Gould 1962	—	1962*
Cruciata pedemontana (Bellardi) Ehrend.	Eurasia	McGregor and Brooks 1983	—	1983*
Galium anglicum Hudson	Eurasia	Lipscomb and Nesom 2007	Sanders 6681 (BRIT)	2005
Galium aparine L.	Eurasia	Cory and Parks 1937	Tracy 8081 (TEX)	1902
Mitracarpus hirtus (L.) DC.	Pantropical	Cory and Parks 1937	Runyon 197 (TEX)	1929
Paederia foetida L.	Eurasia	Brown 1992	Brown 14128 (SBSC)	1989
Richardia brasiliensis Gomes	South America	Cory and Parks 1937	Tharp 1391 (TEX)	1922
Richardia scabra L.	South America	Cory and Parks 1937	Tharp 2657 (TEX)	1923
Sherardia arvensis L.	Eurasia	Gould 1962	Turner 4387 (TEX)	1958
Spermacoce verticillata L.	Neotropical	Correll and Johnston 1970	—	1970*
RUTACEAE				
Citrus aurantium L.	Eurasia	Correll and Johnston 1970	White 112 (TEX)	1912
Poncirus trifoliata (L.) Raf.	Eurasia	Cory and Parks 1937	McKee 3900 (TEX)	1911
Ruta chalepensis L.	South America	Gould 1962	—	1962*
Ruta graveolens L.	Mediterranean	Cory and Parks 1937	Sosa 39 (TEX)	1963
Triphasia trifolia (Burm. f.) P. Wilson	Eurasia	Cory and Parks 1937	Parks 26178 (TAES)	1937

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
SALICACEAE				
Populus alba L.	Eurasia	Gould 1962	Schostag 3087 (TEX)	1910
Populus nigra L.	Eurasia, Africa	Gould 1962	McKee 3901 (TEX)	1911
Salix ×pendulina Wenderoth	Eurasia	Correll and Johnston 1970	Irwin 25 (TAES)	2004
SAPINDACEAE				
Cardiospermum halicacabum L.	Eurasia, Africa	Cory and Parks 1937	—	1937*
Koelreuteria elegans (Seem.) A.C. Sm.	Eurasia	Hatch et al. 1990	—	1990*
SCROPHULARIACEAE				
Bacopa repens (Sw.) Wettst.	Neotropical	Brown and Gandhi 1989	Brown 10662 (SBSC)	1986
Bellardia trixago (L.) All.	Mediterranean	Lipscomb and Ajilsvgi 1982	Lundell 18514 (LL)	1970
Chaenorhinum minus (L.) Lange	Eurasia	Diggs et al. 1997	Taylor 10570 (BRIT)	1972
Kickxia elatine (L.) Dumort.	Eurasia	Johnston 1990	Ertter 5171 (TEX)	1983
Limnophila sessiliflora (Vahl) Blume	Eurasia	Lemke 1989	Emery s.n. (LL)	1967
Linaria vulgaris P. Mill.	Eurasia	Cory and Parks 1937	Killian 35 (TAES)	2000
Lindernia crustacea (L.) F. Muell.	Eurasia	Brown and Marcus 1998	Brown 19703 (SBSC)	1996
Mazus pumilus (Burm. f.)	Eurasia	Godfrey and Wooten 1981	Waller 3456 (TEX)	1975
Parentucellia viscosa (L.) Caruel	Eurasia	Hatch et al. 1990	Amerson s.n. (LL)	1969
Paulownia tomentosa (Thunb.) Sieb. & Zucc. ex Steud.	Eurasia	Cory and Parks 1937	Parks R2618 (TAES)	1940
Verbascum blattaria L.	Eurasia	Cory and Parks 1937	Tharp s.n. (TEX)	1921
Verbascum thapsus L.	Eurasia, Africa	Cory and Parks 1937	Heald 569 (TEX)	1909
Verbascum virgatum Stokes	Eurasia	Gould 1962	—	1962*
Veronica agrestis L.	Eurasia	Hatch et al. 1990	—	1990*
Veronica arvensis L.	Eurasia	Cory and Parks 1937	Lundell 113343 (LL)	1942
Veronica persica Poir.	Eurasia	Cory and Parks 1937	Tharp s.n. (TEX)	1937
Veronica polita Fries	Eurasia	Gould 1962	Williams 74 (TEX)	1927
SIMAROUBACEAE				
Ailanthus altissima (P. Mill.) Swingle	Eurasia	Cory and Parks 1937	Duval 68 (TEX)	1900
SOLANACEAE				
Cestrum diurnum L.	Neotropical	Cory and Parks 1937	Cory 38303 (TAES)	1940
Cestrum nocturnum L.	Neotropical	Correll and Johnston 1970	Traverse 353 (LL)	1957
Cestrum parqui L'Hér.	South America	Cory and Parks 1937	Runyon 128817 (TEX)	1940
Datura inoxia P. Mill.	Neotropical	Cory and Parks 1937	Correll 32229 (LL)	1966
Datura stramonium L.	Eurasia	Cory and Parks 1937	Tharp 52-457 (TEX)	1952
Lycianthes asarifolia (Kunth & Bouché) Bitter	South America	Reed and Ketchersid 1998	Ketchersid 120697-A (TEX)	1997
Lycium barbarum L.	Eurasia	Correll and Johnston 1970	Orr 742 (TEX)	1960
Nicotiana glauca Graham	South America	Cory and Parks 1937	Oberholzer 10 (TEX)	1901

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
SOLANACEAE cont.				
Nicotiana longiflora Cav.	South America	Gould 1962	Iwanicki 7503-3 (TAES)	1975
Nicotiana tabacum L.	Neotropical	Correll and Johnston 1970	Timmons 508 (TAES)	1940
Nierembergia hippomanica Miers	South America	Gould 1962	Williams s.n. (TAES)	1939
Petunia integrifolia (Hook.) Schinz & Thellung	Neotropical	Hatch et al. 1990	Degenhardt 76 (TAES)	1955
Physalis philadelphica Lam.	Neotropical	Correll and Johnston 1970	Marsh 163 (TEX)	1937
Salpichroa origanifolia (Lam.) Baill.	South America	Correll and Johnston 1970	Parks s.n. (TEX)	1946
Schizanthus pinnatus Ruiz & Pavón	South America	Correll and Johnston 1970	—	1970*
Solanum capsicastrum Link ex Schauer	South America	Gould 1962	Boon 220 (TEX)	1943
Solanum capsicoides All.	South America	Cory and Parks 1937	Bray 757 (TEX)	1907
Solanum diphyllum L.	Neotropical	Lemke 1991	Bauml 74-385 (TAES)	1974
Solanum erianthum D. Don	Neotropical	Cory and Parks 1937	Runyon 2107 (TEX)	1939
Solanum lycopersicum L.	Neotropical	Cory and Parks 1937	Patks 17992 (TAES)	1936
Solanum physalifolium Rusby	South America	Cory and Parks 1937	—	1937*
Solanum pseudocapsicum L.	South America	Cory and Parks 1937	Ferguson 754 (TEX)	1901
Solanum sisymbriifolium Lam.	South America	Cory and Parks 1937	McMullen s.n. (TEX)	1927
Solanum viarum Dunal	South America	Reed et al. 2004	Ketchersid 5-2004-1 (TAMU)	2004
SPHENOCLEACEAE				
Sphenoclea zeylanica Gaertn.	Africa	Cory and Parks 1937	Tharp s.n. (TEX)	1929
STERCULIACEAE				
Firmiana simplex (L.) W. Wight	Eurasia	Turner et al. 2003	Duval 4 (TEX)	1919
Melochia corchorifolia L.	Eurasia, Africa	Cory and Parks 1937	Parks 11086 (TAES)	1934
TAMARICACEAE				
Tamarix aphylla (L.) Karst.	Eurasia, Africa	Cory and Parks 1937	Cameron 244 (TEX)	1937
Tamarix chinensis Lour.	Eurasia	Cory and Parks 1937	Schostag 3006 (TEX)	1910
Tamarix gallica L.	Eurasia, Africa	Cory and Parks 1937	Tracy 55 (TEX)	1902
Tamarix parviflora DC.	Eurasia	Gould 1962	Warnock T118 (TEX)	1937
THYMELAEACEAE				
Thymelaea passerina (L.) Coss. & Germ.	Eurasia, Africa	Holmes et al. 2000	Holmes 10173 (BAYLU)	1999
ULMACEAE				
Ulmus parvifolia Jacq.	Eurasia	Reed 2005	Vanwinkle 06 (TAMU)	1979
Ulmus pumila L.	Eurasia	Correll and Johnston 1970	Shinners 17602 (TEX)	1954
URTICACEAE				
Boehmeria nivea (L.) Gaud.	Eurasia	Cory and Parks 1937	Parks 11381 (TAES)	1934
Parietaria judaica L.	Mediterranean	Townsend 1968	—	1968*
Pilea microphylla (L.) Liebm.	Neotropical	Brown and Gandhi 1989	McClure s.n. (SBSC)	1988

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
URTICACEAE cont.				
Urtica urens L.	Eurasia	Cory and Parks 1937	Albers 46031 (LL)	1946
VALERIANACEAE				
Valerianella locusta (L.) Betcke	Eurasia, Africa	Brown et al. 2007	Brown 30341 (SBSC)	2005
VERBENACEAE				
Clerodendron bungei Steud.	Eurasia	Hatch et al. 1990	Cory s.n. (TAES)	1945
Clerodendron indicum (L.) Kuntze	Eurasia	Hatch et al. 1990	—	1990*
Duranta erecta L.	Neotropical	Hatch et al. 1990	Cory 36181 (TAES)	1940
Glandularia ×hybrida (Grönland & Rümpler) Nesom & Pruski	Neotropical	Hatch et al. 1990	—	1990*
Glandularia pulchella (Sweet) Troncoso	South America	Correll and Johnston 1970	Bindwald 28 (TEX)	1930
Lantana camara L.	Pantropical	Cory and Parks 1937	C.C.C. Plant Project s.n. (TEX)	1936
Lantana montevidensis (Spreng.) Briq.	South America	Correll and Johnston 1970	Correll 15443 (LL)	1957
Verbena bonariensis L.	South America	Gould 1962	Tharp s.n. (TEX)	1923
Verbena brasiliensis Vell.	South America	Cory and Parks 1937	Crockett 6961 (LL)	1944
Verbena litoralis Kunth	Neotropical	Gould 1962	Tharp s.n. (TEX)	1939
Verbena rigida Spreng.	South America	Cory and Parks 1937	Palmer 12038 (TEX)	1917
Vitex agnus-castus L.	Mediterranean	Cory and Parks 1937	Gaugh s.n. (TEX)	1921
Vitex negundo L.	Eurasia	Gould 1962	Traverse 1322 (TEX)	1959
VITACEAE				
Cayratia japonica (Thunb.) Gagnepain	Eurasia	Brown 1992	Tveten s.n. (SBSC)	1990
ZYGOPHYLLACEAE				
Kallstroemia maxima	Neotropical	Brown and Gandhi 1989	Lehmann s.n. (TEX)	1934
Peganum harmala L.	Mediterranean	Gould 1962	Cory 31305 (TEX)	1938
Tribulus cistoides L.	Neotropical	Cory and Parks 1937	—	1937*
Tribulus terrestris L.	Eurasia, Africa	Cory and Parks 1937	Tracy 8299 (TEX)	1902
Zygophyllum fabago L.	Eurasia	Worthington 1996	Lyerly s.n. (TEX)	1970
LILIOPSIDA				
ALOACEAE				
Aloe vera (L.) Burm. f.	Mediterranean	Cory and Parks 1937	Tharp 48-29 (TEX)	1948
ARACEAE				
Colocasia esculenta (L.) Schott	Eurasia	Akridge and Fonteyn 1981	Hander s.n. (TEX)	1967
Cryptocoryne beckettii Thwaites ex Trimen	Eurasia	Rosen 2000	Rosen 202 (SWT)	1996
Pistia stratiotes L.	Pantropical	Cory and Parks 1937	Lindheimer 1231 (TEX)	1851
Xanthosoma sagittifolium (L.) Schott	South America	Lemke and Schneider 1988	Litchfield s.n. (SWT)	1976

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
CANNACEAE				
Canna ×generalis Bailey (pro sp.) [glauca × indica]	Neotropical	Hill 1982	Reeves 2046 (TAES)	1943
Canna indica L.	Neotropical	Cory and Parks 1937	—	1937*
COMMELINACEAE				
Callisia repens (Jacq.) L.	South America	Gould 1962	Runyon 676 (TEX)	1924
Commelina communis L.	Eurasia	Cory and Parks 1937	Cory 11460 (TAES)	1934
Gibasis pellucida (Mart. & Gal.) D.R. Hunt	Neotropical	Rosen and Faden 2005	Rosen 2583 (BRIT)	2003
Murdannia nudiflora (L.) Brenan	Eurasia	Gould 1962	Rector s.n. (TAES)	1992
CYPERACEAE				
Bulbostylis barbata (Rottb.) C.B. Clarke	Eurasia, Africa	Jones and Wipff 1992	Wipff 2413 (BRIT)	1992
Cyperus albostriatus Schrad.	Neotropical	Jones et al. 1997	—	2009
Cyperus difformis L.	Eurasia	Lipscomb 1980	Carr 3437 (TEX)	1981
Cyperus entrerianus Bockeler	Neotropical	Carter 1990	Runyon 2761 (TEX)	1941
Cyperus eragrostis Lam.	North America	Brown and Marcus 1998	Kessler 4626 (TAES)	1981
Cyperus involucratus Rottb.	Africa	Gould 1962	Crockett 8355 (LL)	1946
Cyperus iria L.	Neotropical	Cory and Parks 1937	Tharp s.n. (TEX)	1929
Cyperus phaeolepis Cherm.	Africa	Hatch et al. 1990	—	1990*
Cyperus pilosus Vahl	Eurasia, Africa	Carter and Allen 2009	Allen 21098 (BRIT)	2008
Cyperus prolixus Kunth	Neotropical	Hatch et al. 1990	Parks 11361 (TAES)	1934
Cyperus rotundus L.	Neotropical	Cory and Parks 1937	Winkler s.n. (TEX)	1901
DIOSCOREACEAE				
Dioscorea bulbifera L.	Eurasia, Africa	Correll 1972	Amerson 274 (LL)	1970
HYDROCHARITACEAE				
Egeria densa Planch.	South America	Gould 1962	Cory 41779 (TEX)	1943
Hydrilla verticillata (L. f.) Royle	Eurasia, Africa	Flook 1975	Ertter 5483 (TEX)	1984
Ottelia alismoides (L.) Pers.	Eurasia	Brown and Gandhi 1989	Stutzenbaker 150 (TEX)	1966
IRIDACEAE				
Belamcanda chinensis (L.) DC.	Eurasia	Cory and Parks 1937	—	1937*
Crocosmia x *crocosmiiflora* (V. Lemoine) N.E. Br.	Africa	Hatch et al. 1990	—	1990*
Iris pseudacorus L.	Eurasia, Africa	Correll and Johnston 1970	Abrigo s.n. (TEX)	1963
Romulea rosea (L.) Eckl.	Africa	Singhurst et al. 2009	Fleming 1212 (BAYLU)	2005
JUNCACEAE				
Juncus capitatus Weigel	Eurasia, Africa	Correll and Johnston 1970	Tharp 42-02 (TEX)	1941
LEMNACEAE				
Landoltia punctata (G. Mey.) Les & D.J. Crawford	Eurasia, Oceania	Landolt 1986	Massey 242 (LL)	1963

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
LILIACEAE				
Allium porrum L.	Eurasia, Africa	Hatch et al. 1990	—	1990*
Alstroemeria pulchella L.f.	South America	Singhurst et al. 2005	Keith 717 (BAYLU)	2004
Amaryllis belladonna L.	Africa	Correll and Johnston 1970	—	1970*
Asparagus officinalis L.	Eurasia, Africa	Cory and Parks 1937	Gough s.n. (TEX)	1921
Crinum bulbispermum (Burm. f.)	Africa	Gould 1962	Traverse 2069 (TEX)	1961
Habranthus tubispathus (L'Hér.) Traub	South America	Holmes and Wells 1980	Young s.n. (TEX)	1914
Hemerocallis fulva (L.) L.	Eurasia	Cory and Parks 1937	—	1937*
Hemerocallis lilioasphodelus L.	Eurasia	Hatch et al. 1990	—	1990*
Hippeastrum bifidum (Herb.) Bak.	South America	Neill and Wilson 2001	Neill 2244 (TAMU)	1988
Hippeastrum puniceum (Lam.) Kuntze	Neotropical	Holmes 2002	—	2002*
Hyacinthus orientalis L.	Mediterranean	Hatch et al. 1990	—	1990*
Lilium philippinense Baker	Eurasia	Brown and Elsik 2002	Schultz 061 (SBSC)	1991
Lycoris radiata (L'Hér.) Herbert	Eurasia	Diggs et al. 2006	Correll s.n. (LL)	1965
Muscari botryoides (L.) Mill.	Eurasia	Straley and Utech 2002	—	2002*
Muscari comosum (L.) Mill.	Eurasia, Africa	Luckeydoo 2005	Ness s.n. (TAES)	1899
Muscari neglectum Guss. ex Ten.	Eurasia, Africa	Gould 1962	Painter s.n. (TEX)	1923
Narcissus jonquilla L.	Eurasia	Gould 1962	Dixon 34	1956
Narcissus pseudonarcissus L.	Eurasia	Gould 1962	Reeves 1998 (TAES)	1941
Narcissus tazetta L.	Mediterranean	Gould 1962	Reeves 363 (TAES)	1940
Ornithogalum umbellatum L.	Eurasia, Africa	Hatch et al. 1990	—	1990*
Tristagma uniflorum (Lindl.)	South America	Correll and Johnston 1970	—	1970*
Zephyranthes candida (Lindl.) Herbert	South America	Cory and Parks 1937	Parks 15347 (TAES)	1935
Zephyranthes grandiflora Lindl.	Neotropical	Brown et al. 2007	Keith 853 (SBSC)	2005
LIMNOCHARITACEAE				
Hydrocleys nymphoides (Humb. & Bonpl. ex Willd.) Buch.	South America	Cory and Parks 1937	Dexter s.n. (LL)	1975
ORCHIDACEAE				
Zeuxine strateumatica (L.) Schltr.	Eurasia, Oceania	Brown and Gandhi 1989	Opperman s.n. (SBSC)	1988
POACEAE				
Aegilops cylindrica Host	Mediterranean	Gould 1962	Cory 29689 (TEX)	1938
Agropyron cristatum (L.) Gaertn.	Eurasia	Gould 1962	—	1962*
Agrostis avenacea J.F. Gmel.	Oceania	Cory and Parks 1937	Tracy 403 (TEX)	1902
Agrostis stolonifera L.	Eurasia	Cory and Parks 1937	McClung 6689 (TEX)	1926
Aira caryophyllea L.	Eurasia, Africa	Cory and Parks 1937	Brown 5307 (TAES)	1981
Alopecurus geniculatus L.	Eurasia	Hulten and Fries 1986	—	1986*
Alopecurus myosuroides Huds.	Eurasia	Gould 1962	—	1962*

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
POACEAE cont.				
Amelichloa clandestina (Hack.) Arriaga & Barkworth	Neotropical	Barkworth 1993	Landers s.n. (TAES)	1988
Anthoxanthum aristatum Boiss.	Eurasia, Africa	Cory and Parks 1937	—	1937*
Anthoxanthum odoratum L.	Eurasia	Cory and Parks 1937	Martin s.n. (TAES)	1898
Arthraxon hispidus (Thunb.) Makino	Eurasia	Brown and Schultz 1991	Schultz 0308A (SBSC)	1991
Arundo donax L.	Mediterranean	Cory and Parks 1937	Young s.n. (TEX)	1915
Avena fatua L.	Eurasia	Gould 1962	Silveus 99 (LL)	1931
Avena sativa L.	Eurasia	Gould 1962	Collier s.n. (TAES)	1938
Bothriochloa bladhii (Retz.) S.T. Blake	Eurasia, Africa	Gould 1962	Higdon H439 (TEX)	1939
Bothriochloa ischaemum (L.) Keng	Eurasia	Gould 1962	Silveus 140 (LL)	1935
Bothriochloa pertusa (L.) A. Camus	Eurasia, Africa	Gould 1962	Lundell 15037 (LL)	1953
Brachypodium distachyon (L.) Beauv.	Eurasia	Hatch et al. 1990	Matthews s.n. (TAES)	1957
Briza maxima L.	Mediterranean	Correll and Johnston 1970	—	1970*
Briza minor L.	Mediterranean	Gould 1962	Silveus 6965A (LL)	1941
Bromus arvensis L.	Eurasia	Correll and Johnston 1970	—	1970*
Bromus catharticus Vahl	South America	Cory and Parks 1937	Tracy 8111 (TEX)	1902
Bromus commutatus Schrad.	Eurasia	Cory and Parks 1937	Nighswonger 317 (TAES)	1967
Bromus diandrus Roth	Eurasia	Cory and Parks 1937	Silveus 858 (TEX)	1933
Bromus hordeaceus L.	Eurasia, Africa	Cory and Parks 1937	Silveus 7022 (LL)	1932
Bromus inermis Leyss.	Eurasia	Correll and Johnston 1970	Reed 500 (LL)	1948
Bromus japonicus Thunb. ex Murr.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1915
Bromus lanceolatus Roth	Eurasia	Hatch et al. 1990	Silveus 1557 (TEX)	1937
Bromus rubens L.	Eurasia	Gould 1962	Cory 37024 (TAES)	1941
Bromus secalinus L.	Eurasia	Cory and Parks 1937	Reverchon 2383 (TEX)	1901
Bromus sterilis L.	Eurasia	Warren and Hatch 1984	Warren 46 (TAES)	1983
Bromus tectorum L.	Eurasia	Cory and Parks 1937	Cory 54369 (LL)	1948
Chloris canterae (canterai) Arechav.	South America	Correll and Johnston 1970	Silveus 524 (TEX)	1932
Chloris divaricata R. Br.	Oceania	Hatch et al. 1990	Silveus 2564 (TAES)	1940
Chloris gayana Kunth	Pantropical	Cory and Parks 1937	Silveus 2609 (TEX)	1934
Coix lacryma-jobi L.	Eurasia	Cory and Parks 1937	Lackey s.n. (TAES)	1982
Cortaderia selloana (J.A. & J.H. Schultes) Aschers. & Graebn.	South America	Gould 1962	Silveus 308 (TEX)	1931
Cynodon aethiopicus W.D. Clayton & Harlan	Africa	Jones et al. 1997	Lonard 5025 (TAES)	1984
Cynodon dactylon (L.) Pers.	Eurasia, Africa	Cory and Parks 1937	Hitchcock 5468 (LL)	1910
Cynodon magennisii Hurcombe	Africa	Jones et al. 1997	—	1997*
Cynodon nlemfuensis Vanderyst	Africa	Jones and Jones 1992	Lievens 2000 (TAES)	1987
Cynodon transvaalensis Burtt-Davy	Africa	Jones et al. 1997	—	1997*

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
POACEAE cont.				
Cynosurus echinatus L.	Eurasia	Thomas 2003	Thomas 129383 (BRIT)	1992
Dactylis glomerata L.	Eurasia, Africa	Correll and Johnston 1970	Cox s.n. (LL)	1949
Dactyloctenium aegyptium (L.) Willd.	Africa	Cory and Parks 1937	Bush 1368 (TEX)	1900
Desmazeria rigida (L.) Tutin	Eurasia	Cory and Parks 1937	Silveus 7022 (TAES)	1939
Dichanthium annulatum (Forssk.) Stapf	Eurasia	Gould 1962	Silveus 7434 (LL)	1941
Dichanthium aristatum (Poir.) C.E. Hubbard	Eurasia	Gould 1962	Silveus 7434 (TEX)	1941
Dichanthium sericeum (R. Br.) A. Camus	Oceania	Gould 1962	Silveus 7307 (TEX)	1941
Digitaria ischaemum (Schreb.) Schreb. ex Muhl.	Eurasia	Gould 1962	Shinners 30704 (TEX)	1964
Digitaria milanjiana (Rendle) Stapf	Africa	Hatch et al. 1990	—	1990*
Digitaria sanguinalis (L.) Scop.	Eurasia	Gould 1962	Young 9a (TEX)	1918
Digitaria violascens Link	Eurasia, Africa	Gould 1962	Silveus 6451 (TEX)	1940
Echinochloa colona (L.) Link	Eurasia, Africa	Gould 1962	Letterman s.n. (TEX)	1894
Echinochloa crus-galli (L.) Beauv.	Eurasia	Gould 1962	Prince 1285 (LL)	1906
Ehrharta calycina Sm.	Africa	Turner et al. 2003	Sigut 29 (TAES)	1950
Eleusine indica (L.) Gaertn.	Africa	Cory and Parks 1937	Heald 160 (TEX)	1908
Elymus repens (L.) Gould	Eurasia	Cory and Parks 1937	—	1937*
Eragrostis airoides Nees	South America	Hatch and Clark 1977	Clark 3075 (TAES)	1974
Eragrostis amabilis (L.) Wight & Arn. ex Nees	Eurasia, Africa	Cory and Parks 1937	—	1937*
Eragrostis barrelieri Daveau	Eurasia	Cory and Parks 1937	Tracy 7917 (TEX)	1902
Eragrostis cilianensis (All.) Vign. ex Janchen	Eurasia	Cory and Parks 1937	A. N. P. 1222 (LL)	1906
Eragrostis curvula (Schrad.) Nees	Africa	Gould 1962	Silveus 4663 (TEX)	1937
Eragrostis lehmanniana Nees	Africa	Gould 1962	Diaz H40 (TEX)	1937
Eragrostis minor Host	Eurasia	Cory and Parks 1937	Reeder 5922 (TEX)	1972
Eragrostis pilosa (L.) P. Beauv.	Eurasia	Gould 1962	Tharp 6730 (TEX)	1929
Eragrostis superba Peyr.	Africa	Hatch et al. 1990	Emery 844 (TEX)	1958
Eremochloa ophiuroides (Munro) Hack.	Eurasia	Gould 1962	Brown 3458 (TEX)	1947
Eriochloa pseudoacrotricha (Stapf ex Thell.) J.M. Black	Oceania	Hatch et al. 1990	—	1990*
Eustachys caribaea (Spreng.) Herter	South America	Wipff and Hatch 1992	Silveus 1440 (TEX)	1936
Eustachys retusa (Lag.) Kunth	South America	Correll and Johnston 1970	C.C.C. s.n. (TEX)	1936
Gastridium phleoides (Nees & Meyen) C.E. Hubbard	Eurasia, Africa	Cory and Parks 1937	—	1937*
Glyceria declinata Brébiss	Eurasia	Allen et al. 2009	Allen 20732 (BRIT)	2008
Hackelochloa granularis (L.) Kuntze	Eurasia, Africa	Correll and Johnston 1970	—	1970*
Hainardia cylindrica (Willd.) Greuter	Eurasia	Hatch et al. 1990	Waller 2661 (TEX)	1974
Hemarthria altissima (Poir.) Stapf & C.E. Hubbard	Mediterranean	Cory and Parks 1937	Tharp 7889 (TEX)	1931
Heteropogon melanocarpus (Ell.) Benth.	Eurasia	Cory and Parks 1937	Diaz s.n. (TEX)	1939

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
POACEAE cont.				
Holcus lanatus L.	Eurasia	Cory and Parks 1937	Fleetwood 11746 (TAES)	1975
Hordeum murinum L.	Eurasia	Cory and Parks 1937	Silveus 163 (TEX)	1931
Hordeum vulgare L.	Eurasia	Gould 1962	Armer 5314 (TEX)	1929
Imperata cylindrica (L.) Beauv.	Eurasia	Diggs et al. 2006	Wolfe s.n. (TAES)	1991
Ixophorus unisetus (J. Presl) Schltdl.	Neotropical	Turner et al. 2003	Perdue 1642 (TAES)	1954
Lamarckia aurea (L.) Moench	Mediterranean	Cory and Parks 1937	—	1937*
Leptochloa chloridiformis (Hack. ex Stuck.) Parodi	South America	Cory and Parks 1937	Silveus 622 (TEX)	1932
Lolium perenne L.	Eurasia	Cory and Parks 1937	Young s.n. (TEX)	1915
Lolium rigidum Gaudin	Eurasia, Africa	Jones et al. 1997	—	1997*
Lolium temulentum L.	Eurasia	Cory and Parks 1937	Tharp 1067 (TEX)	1921
Luziola peruviana Juss. ex J. F. Gmel.	Neotropical	Hatch et al. 1998b	Hatch 6746 (TAES)	1997
Melinis repens (Willd.) Zizka	Eurasia, Africa	Correll and Johnston 1970	Silveus 86 (TEX)	1930
Microstegium vimineum (Trin.) A. Camus	Eurasia	Nixon and Damuth 1987	McCrary 1097 (ATSC)	1987
Moorochloa eruciformis (Sm.) Veldkamp	Mediterranean	Fox et al. 1996	Hansen s.n. (TAES)	1992
Oryza sativa L.	Eurasia	Gould 1962	Silveus 7372 (LL)	1941
Panicum antidotale Retz.	Eurasia	Gould 1962	Siveus 2154 (TAES)	1937
Panicum bergii Arech.	South America	Cory and Parks 1937	Tharp 6712 (TEX)	1929
Panicum coloratum L.	Africa	Hatch et al. 1990	Silveus 7203 (TEX)	1941
Panicum miliaceum L.	Eurasia	Cory and Parks 1937	Silveus 2530 (TEX)	1935
Panicum repens L.	Eurasia, Africa	Cory and Parks 1937	Tharp 3100 (TEX)	1924
Panicum trichoides Sw.	Neotropical	Gould 1962	Runyon 1873 (TEX)	1938
Parapholis incurva (L.) C.E. Hubbard	Eurasia, Africa	Gould 1962	Gould 6770 (TEX)	1955
Paspalum almum Chase	South America	Cory and Parks 1937	Higdon s.n. (TEX)	1936
Paspalum convexum Humb. & Bonpl. ex Flueggé	Neotropical	Gould 1962	Silveus 7384 (TEX)	1941
Paspalum dilatatum Poir.	South America	Cory and Parks 1937	Ruth 163 (TEX)	1910
Paspalum malacophyllum Trin.	Neotropical	Hatch et al. 1990	Lonard 1990 (TEX)	1967
Paspalum modestum Mez	South America	Correll and Johnston 1970	—	1970*
Paspalum notatum Flueggé	South America	Cory and Parks 1937	Silveus 2358 (LL)	1931
Paspalum scrobiculatum L.	Eurasia	Cory and Parks 1937	Ness s.n. (TAES)	1926
Paspalum urvillei Steud.	South America	Cory and Parks 1937	Hitchcock 964 (LL)	1910
Pennisetum ciliare (L.) Link	Eurasia, Africa	Gould 1962	Perdue 1522 (LL)	1953
Pennisetum glaucum (L.) R. Br.	Eurasia	Cory and Parks 1937	Hill s.n. (TAES)	1990
Pennisetum nervosum (Nees) Trin.	South America	Cory and Parks 1937	Runyon 3404 (TEX)	1938
Pennisetum purpureum Schumach.	Africa	Jones et al. 1997	Silveus 375 (TEX)	1931
Pennisetum villosum R. Br. ex Fresen.	Africa	Cory and Parks 1937	Allen s.n. (TEX)	1921

Table 2 - continued

Scientific Name	Origin	Reference	Voucher	Date
POACEAE cont.				
Phalaris arundinacea L.	Eurasia, Africa	Hatch et al. 2004	Higgins 12099 (WTU)	1978
Phalaris brachystachys Link	Mediterranean	Cory and Parks 1937	Silveus 512 (TEX)	1932
Phalaris canariensis L.	Eurasia	Cory and Parks 1937	Runyon 5842 (TEX)	1931
Phalaris minor Retz.	Mediterranean	Cory and Parks 1937	Pollock 9 (TAES)	1983
Phleum pratense L.	Eurasia	Cory and Parks 1937	McClung 6694 (TEX)	1926
Phyllostachys aurea Carrière ex Rivière & C. Rivière	Eurasia	Borowski et al. 1996	Holmes 7805 (BAYLU)	1995
Poa annua L.	Eurasia	Cory and Parks 1937	Fleetwood 9663 (TEX)	1910
Poa bulbosa L.	Eurasia	Hatch et al. 1990	—	1990*
Poa compressa L.	Eurasia	Cory and Parks 1937	Hynes s.n. (TEX)	1924
Poa trivialis L.	Eurasia	Jones et al. 1997	Reed s.n. (TAES)	1995
Polypogon monspeliensis (L.) Desf.	Eurasia	Cory and Parks 1937	Tracy 435 (TEX)	1902
Polypogon viridis (Gouan) Breistr.	Eurasia	Cory and Parks 1937	Tracy 433 (TEX)	1902
Psathyrostachys juncea (Fisch.) Nevski	Eurasia	Jones et al. 1997	—	1997*
Rostraria cristata (L.) Trin.	Eurasia	Cory and Parks 1937	Fleetwood 9739 (TEX)	1970
Rottboellia cochinchinensis (Lour.) Clayton	Eurasia	Wipff and Rector 1993	Wipff 2459 (BRIT)	1992
Saccharum officinarum L.	Eurasia, Oceania	Hatch et al. 1990	—	1990*
Sacciolepis indica (L.) Chase	Eurasia, Africa	Hatch et al. 1990	Carr 11401 (TEX)	1991
Schedonorus arundinaceus (Schreb.) Dumort.	Eurasia	Gould 1962	Shinners 18819 (TEX)	1954
Schedonorus pratensis (Huds.) P. Beauv.	Eurasia	Gould 1962	Godwin 32058 (TAES)	1939
Schismus arabicus Nees	Eurasia	Barkworth et al. 2007	—	2007*
Schismus barbatus (Loefl. ex L.) Thell.	Eurasia	Gould 1962	Cory 27989 (TEX)	1938
Sclerochloa dura (L.) P. Beauv.	Eurasia	Correll and Johnston 1970	Shinners 19751 (TEX)	1955
Secale cereale L.	Mediterranean	Cory and Parks 1937	Clark 3208 (TAES)	1975
Setaria italica (L.) P. Beauv.	Eurasia	Cory and Parks 1937	Silveus 2372 (LL)	1935
Setaria pumila (Poir.) Roem. & Schult.	Africa	Barkworth et al. 2007	Reverchon s.n. (TEX)	1873
Setaria verticillata (L.) P. Beauv.	Eurasia	Cory and Parks 1937	Tharp s.n. (TEX)	1928
Setaria viridis (L.) P. Beauv.	Eurasia	Cory and Parks 1937	Eggert s.n. (TEX)	1900
Sorghum bicolor (L.) Moench	Africa	Gould 1962	Edwards s.n. (LL)	1916
Sorghum halepense (L.) Pers.	Mediterranean	Cory and Parks 1937	Phipps s.n. (TEX)	1963
Stenotaphrum secundatum (Walter) Kuntze	Pantropical	Cory and Parks 1937	Runyon 712 (TEX)	1923
Themeda triandra Forssk.	Eurasia	Turner et al. 2003	Wendt 6988 (TEX)	1997
Thinopyrum intermedium (Host) Barkworth & D.R. Dewey	Eurasia	Jones et al. 1997	—	1997*
Thinopyrum ponticum (Podp.) Z.W. Liu & R.R.-C. Wang	Eurasia	Jones et al. 1997	—	1997*
Thinopyrum pycnanthum (Godr.) Barkworth	Eurasia	Jones et al. 1997	—	1997*
Triraphis mollis R. Br.	Oceania	Hatch et al. 1998a	Godwin s.n. (TAES)	1993

Table 2 - continued

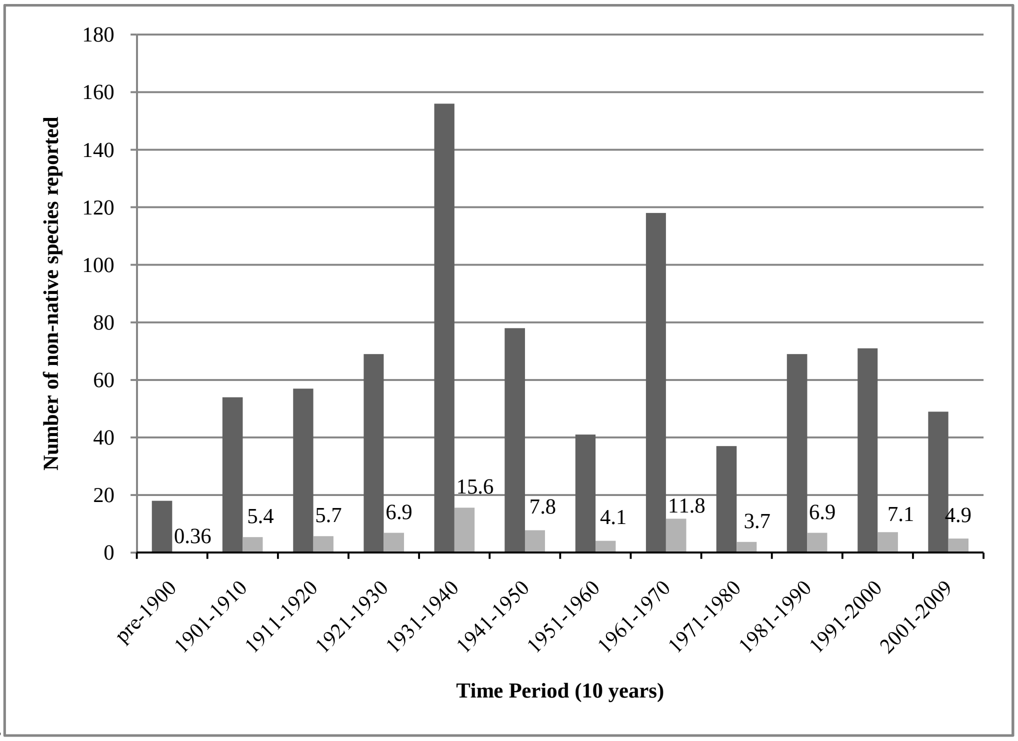
Scientific Name	Origin	Reference	Voucher	Date
POACEAE cont.				
Triticum aestivum L.	Eurasia	Gould 1962	Silveus 7715 (TEX)	1938
Urochloa brizantha (Hochst. ex A. Rich.) R. Webster	Africa	Fox et al. 1996	Landers s.n. (TAES)	1993
Urochloa maxima (Jacq.) R. Webster	Africa	Gould 1962	Silveus 170 (TEX)	1931
Urochloa mosambicensis (Hack.) Dandy	Africa	Wipff et al. 1993	Canales 9 (TAES)	1992
Urochloa mutica (Forssk.) T.Q. Nguyen	Africa	Cory and Parks 1937	Silveus 396-A	1931
Urochloa panicoides P. Beauv.	Africa	Hatch et al. 1990	Jones 7872 (TAES)	1992
Urochloa plantaginea (Link) R.D. Webster	Africa	Cory and Parks 1937	Lundell 15009 (LL)	1949
Urochloa ramosa (L.) T.Q. Nguyen	Eurasia, Africa	Jones et al. 1997	Brown 16589 (TEX)	1992
Urochloa reptans (L.) Stapf	Pantropical	Cory and Parks 1937	Tracy 7387 (TEX)	1901
Vulpia bromoides (L.) Gray	Eurasia	Correll and Johnston 1970	Lonard 2094 (TAES)	1968
Vulpia myuros (L.) C.C. Gmel.	Eurasia, Africa	Cory and Parks 1937	Brown s.n. (TEX)	1949
Zea mays L.	Neotropical	Correll and Johnston 1970	Banks s.n.	1964
Zea perennis (Hitchc.) Reeves & Manglesdorf	Neotropical	Turner et al. 2003	—	2003*
Zoysia japonica Steud.	Eurasia	Barkworth et al. 2007	Wiese s.n. (TAES)	1970
Zoysia matrella (L.) Merr.	Eurasia, Oceania	Barkworth et al. 2007	—	2007*
Zoysia pacifica (Goudswaard) M. Hotta & S. Kuroki	Eurasia, Oceania	Barkworth et al. 2007	—	2007*
PONTEDERIACEAE				
Eichhornia crassipes (Mart.) Solms	South America	Cory and Parks 1937	Runyon 5251 (TEX)	1925
POTAMOGETONACEAE				
Potamogeton crispus L.	Eurasia, Africa	Correll and Johnston 1970	Tharp s.n. (TEX)	1942

***No voucher record found, date used is of earliest publication or known collection in the state**
****Species not yet reported in a checklist or flora for the state of Texas**

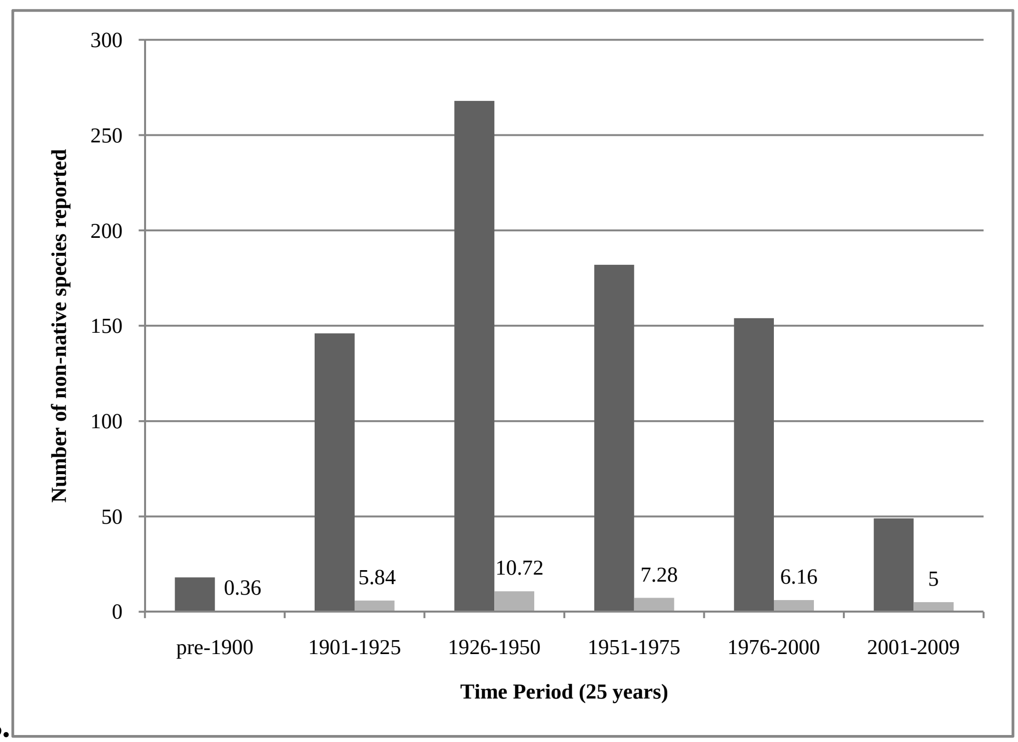
There are several families with no members native to Texas that have been introduced into Texas and contain exclusively non-native species. These 11 families are: Tamaricaceae (4), Combretaceae (2), Molluginaceae (2), Dipsacaceae (2), Salviniaceae (2), Cannabaceae (1), Limnocharitaceae (1), Lygodiaceae (1), Meliaceae (1), Myrsinaceae (1) and Parkeriaceae (1).

Timeline of Non-native Species Discovery

The non-native species were graphed according to the earliest voucher date found and earliest publication if there was no voucher located (Figure 3). Two species (*Indigofera hirsuta, Manihot grahamii*) have not yet been recorded on any list as cultivated or otherwise. Both of these species were collected in 2009 and will soon be reported and published by the author (Aplaca). The dates in table 2 are not necessarily the date of introduction, but represent an approximate time of introduction or discovery in the state. The times of introduction into the state are hard to determine as there is a period between when a species is introduced and when it has become naturalized in the state. This date will be referred to as the “date of discovery.” The species discoveries were graphed in 10-year (Figure 3A) and 25-year increments (Figure 3B). Species introduced per year were also calculated by dividing the number of species by years in the period. There were only 18 non-native species collected before the year 1900. The first partition is from the earliest collection of a non-native species in 1850 (*Malvastrum coromandelianum*, Lindheimer 682 TEX) to the year 1900 and therefore is a 50 year period. In both graphs the first time period “pre-1900,” had a low rate of introduction of 0.36 species per year because of the longer time period and fewer number of non-native species collected than the others. Average number of species per year of introduction for



A.



B.

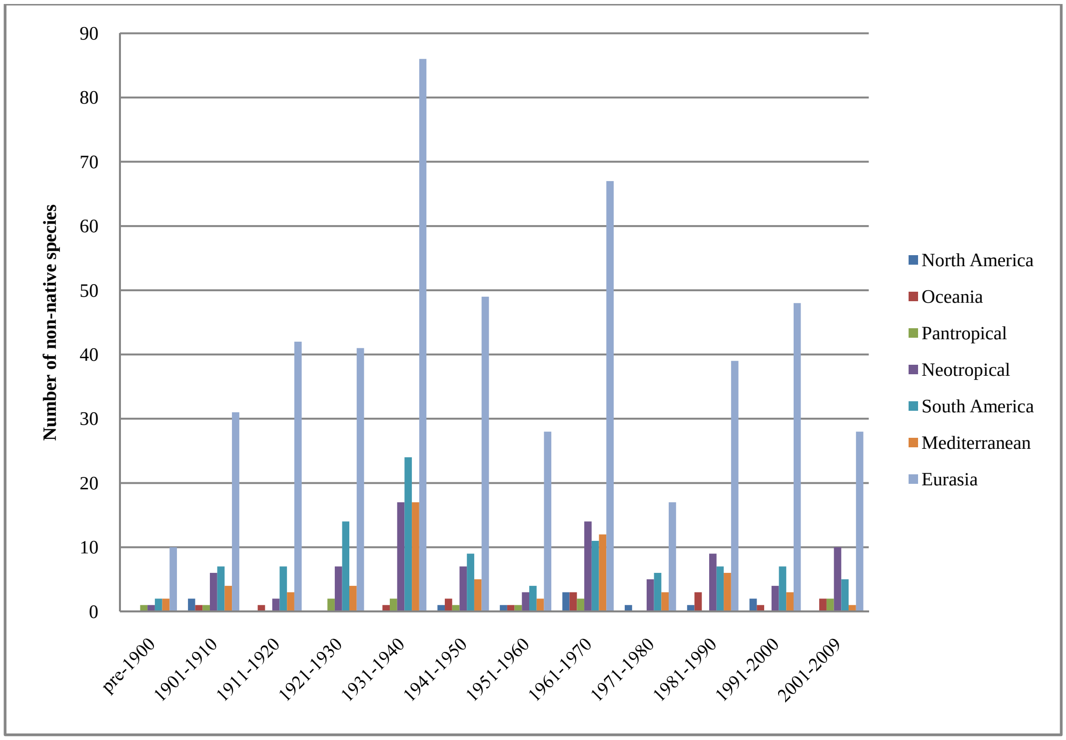
Figure 3 – Distribution of non-native species vouchers or records over time. A. 10 year increments. B. 25 year increments. Gray bars and values show the species per year rate of introduction during that time period.

the 10-year and 25-year graphs were 6.69 (Standard deviation – 3.93) and 5.89 (Standard deviation – 3.36) respectively. There were two decades (1931-1940 and 1961-1970) that represent the steep peaks in Figure 7A that had values outside of the standard deviation. These steep peaks coincide with the work leading up to two major checklists of the plants of Texas (Cory and Parks 1937, Correll and Johnston 1970) (Figure 3A). Using 25 year increments the graph shows that non-native species introductions into the state saw a peak from 1926-1950 and have been declining since then (Figure 3B).

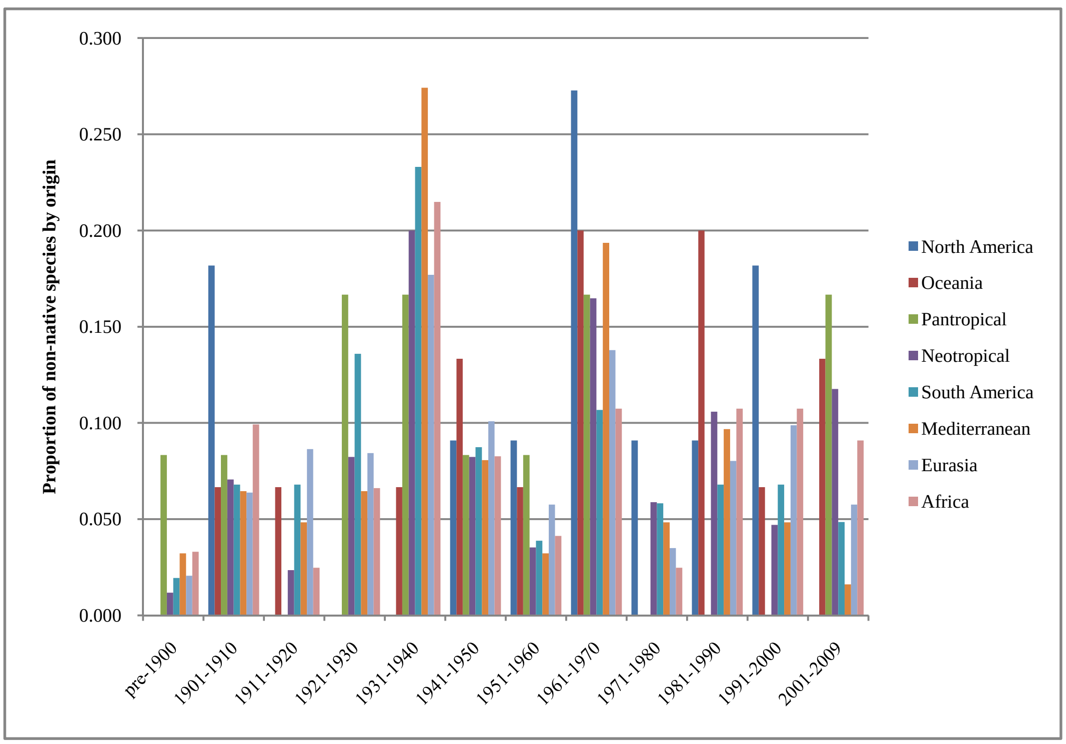
Geographic Origins of Non-native Species in Texas

Many species of the non-native plants in Texas originated from more than one continent. The largest numbers of non-native species in Texas originated from Eurasia (406, 49.5 percent), with the Americas (including North and South America and Neotropical) having the next highest number of non-native species naturalized in Texas (203, 24.8 percent) (Table 3). The majority of non-native species originated in the Old World, including Eurasia, Africa and the Mediterranean (594, 72.6 percent).

There is some indication of a temporal pattern of introduction of non-native species from particular regions (Figure 4). The largest peak of actual species numbers for five out of the eight geographic origins (Africa, Eurasia, Mediterranean, Neotropical and South America) was during the decade from 1931-1940 with a second peak from 1961-1970 (Figure 4A). These peaks correspond with the research leading up to the publication of the checklists by Cory and Parks (1937) and Correll and Johnston (1970). Species originating from Africa, Eurasia, Mediterranean and South America have been collected in each time period since before 1900. There were 5 decades during which species originating from North America outside of Texas were not collected in the state.



A.



B.

Figure 4 – Distribution through 10 year increments of proportions of non-native species separated by origin. A. Actual numbers of species. B. Proportions of species in relation to total number from each region.

Table 3 – Origins of non-native plant species in Texas.

Continent or Region	no. of species	% of total
Africa	46	5.6
Eurasia	405	49.5
Eurasia, Africa	75	9.1
Eurasia, Oceania	6	0.7
Mediterranean	62	7.6
Neotropical	85	10.4
North America	15	1.8
Oceania	9	1.1
Pantropical	12	1.5
South America	102	12.5

Species with origins from North America show a large peak from 1961-1970 which may show an introduction of more ornamental species that became naturalized. Collections of species from Pantropical areas and Oceania were not made in 4 and 3 of the 12 time periods respectively (Figure 4).

Analyses of the Five Largest Families of Non-natives Species

The five families with the most non-native species are Poaceae (163), Fabaceae (69), Asteraceae (65), Brassicaceae (42) and Lamiaceae (24) (Table 4). Poaceae makes up 19.9 percent of the total non-native flora of Texas. Together these four families make up about 44.4 percent of all the non-native species in Texas. Compared with the top ten families of world floras analyzed by Pysek (1998a) the non-native flora of Texas differs with having a greater percentage of Fabaceae (8.4) than Asteraceae (8.0) (Table 4), whereas Asteraceae averages 13.5 percent of the non-native species of world floras. All of the ten families except for Asteraceae fall within the standard deviation (SD) of the world non-native floras values. The rest of the families of the non-native flora of Texas generally correspond with the patterns found in floras throughout the world. The non-native species of Poaceae make up 28.4 percent of the total native and non-native species of Poaceae in the state, which is a large percentage compared to the non-native Fabaceae and Asteraceae, which comprise 18.8 and 10.2 percent of the total native and non-native species in their families in the state respectively.

Table 4 –Taxonomic distribution of the ten largest non-native plant families in Texas in terms of species number compared to the world non-native floras.

Family	# of species	% of Non-native flora	% of World Non-native floras (SD)
Poaceae	163	19.9	15.3 (5.8)
Fabaceae	69	8.4	8.7 (4.4)
Asteraceae	65	8.0	13.5 (4.1)
Brassicaceae	42	5.1	5.1 (3.8)
Lamiaceae	24	2.9	2.3 (1.4)
Caryophyllaceae	24	2.9	3.0 (2.2)
Solanaceae	24	2.9	3.3 (2.5)
Liliaceae	22	2.7	1.6 (2.7)
Apiaceae	20	2.4	1.8 (1.4)
Chenopodiaceae	18	2.2	3.0 (3.2)

The five families with the most non-native species were graphed according to the time the species were collected in the state (Figure 5). Each proportion was the number of non-native species in the specific family collected during that time period in relation to the total number of non-native species from that family. Total non-native species proportions were also included in the graph as the first bar for comparison (Figure 5). Members of the five families were collected in each time period except “pre-1900” when no non-native species of Brassicaceae and Lamiaceae were collected. The timeline of introduction graph of these five families shows a slight similarity to the total species and geographic origins timeline graphs (Figure 4) with general peaks during the 1931-1940 and 1961-1970 decades. There are still large peaks of several families throughout the graph. Fabaceae, Brassicaceae and Lamiaceae have peaks during

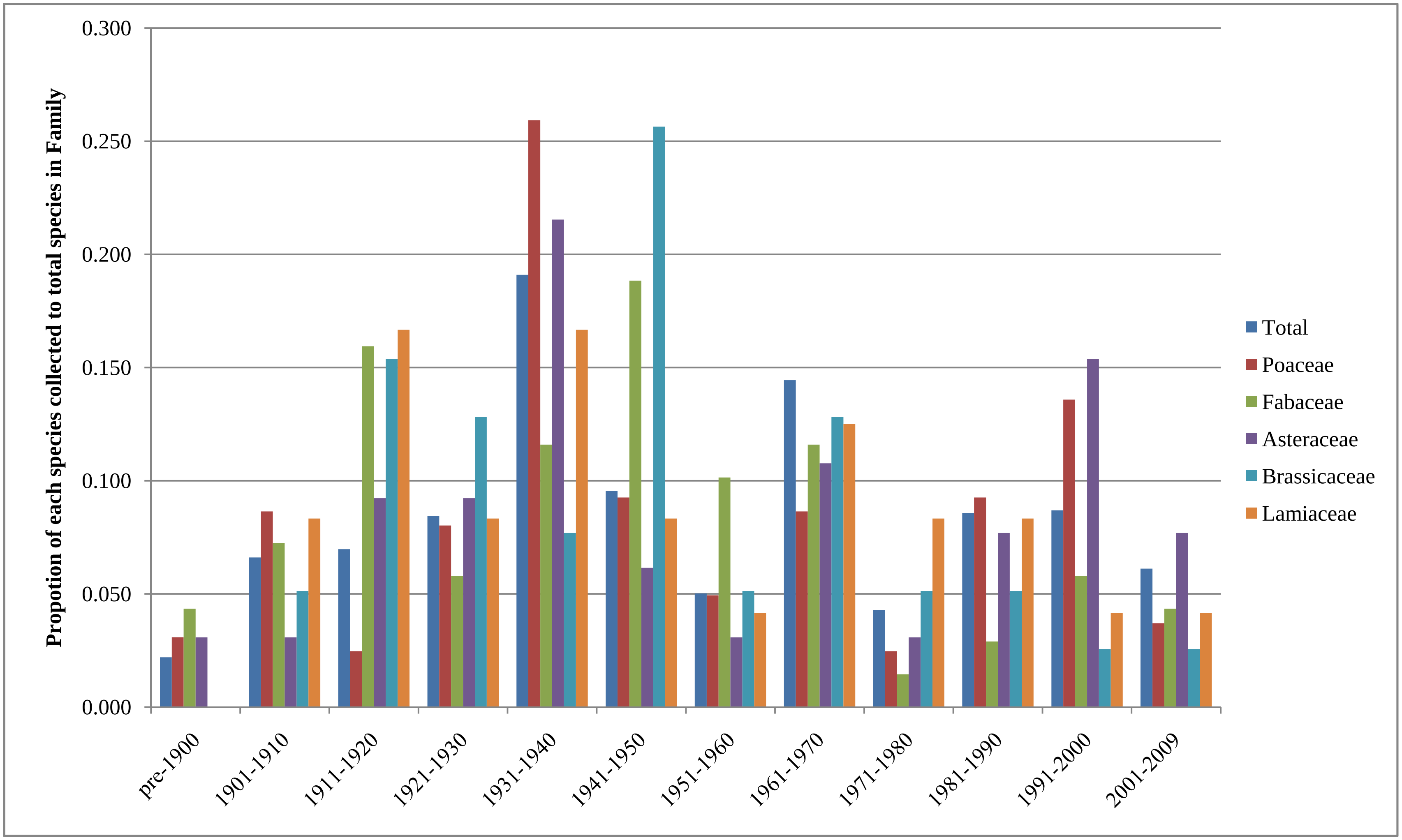


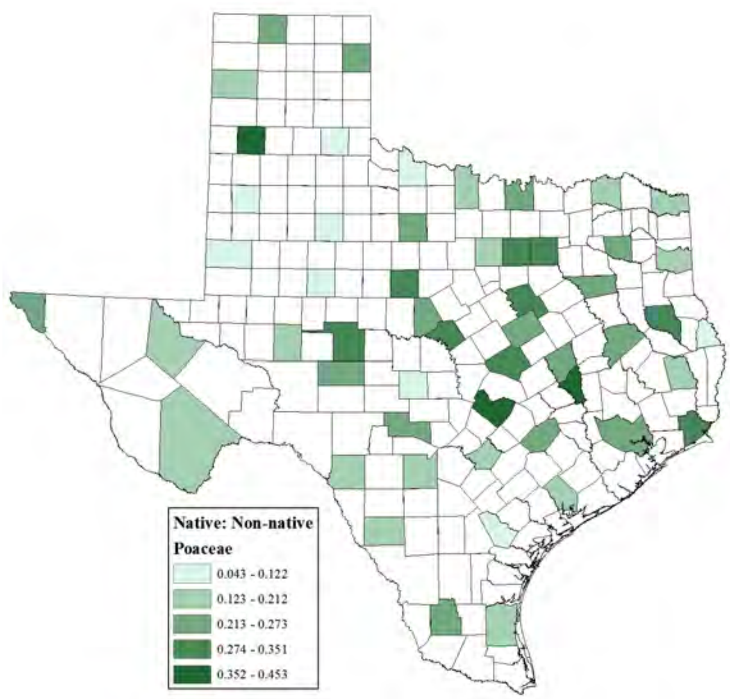
Figure 5 – Proportions of the five largest families of non-native species and their discovery in Texas over 10-year periods. Estimated time is when the species were reported in the state through vouchers or publications.

1911-1920. During 1961-1970, Poaceae and Asteraceae both had high peaks and during 1941-1950 Fabaceae had a high peak and Brassicaceae had an extremely high peak.

These five families with the most non-native species represented in the state were graphed in the 53 selected counties (Poaceae, Fabaceae, Asteraceae, Brassicaceae and Lamiaceae). The non-native species from these families have characteristics that make them adapted to various habitats and this is exhibited in their distribution throughout Texas (Figure 6). The proportion was calculated as non-native to native species in each family to correct for the fact that some counties may have been more heavily collected by botanists. This was used to identify patterns in how these families are distributed throughout the state and if there is any relationship to other factors. Poaceae has higher ratios of non-native species through the central part of the state (Figure 6A) and Fabaceae has higher proportions of non-natives to natives in the western half of the state where there is less precipitation (Figure 6B). The distribution of non-native Asteraceae is not centered in any particular area of the state, but has particular counties distributed throughout the state with high ratios of non-native species (Figure 6C). Brassicaceae has several counties with high ratios in the north central and eastern areas of the state (Figure 6D). There are three counties (Clay, Jefferson and Wilbarger) that only have non-native species of Brassicaceae recorded from them. Lamiaceae has a smaller number of non-native species in Texas (24, Table 4), but there were high ratios through the central area of the state (Figure 6E).

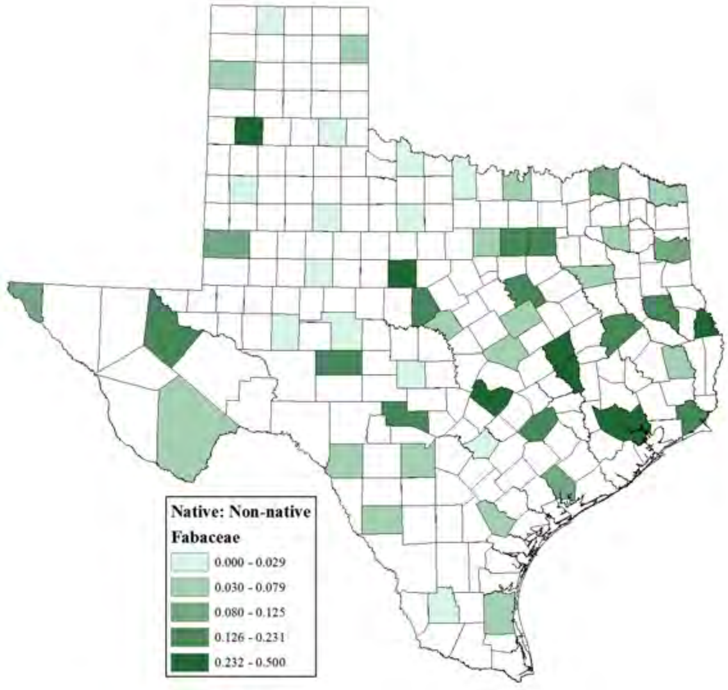
The ratio of non-native to native plants in each of these families was also compared with the ratio of total non-native to native species in each family present in a county (Figure 7). The scatter plots show patterns in total non-natives to natives differ between families. The slopes of the two largest non-native families have similar slopes of 1.5 with Poaceae having the highest R^2 of 0.60 (Figure 7). Poaceae is the only family with a non-native species in each of the selected counties which illustrates the large number of non-native Poaceae in the flora of the state. Brassicaceae had a higher slope (2.02) because there were several counties in which the only representatives of Brassicaceae in the county were non-native species. Brassicaceae is a relatively large family in the state and there should have been native representatives in each of the counties.

The five families with the most non-native species were analyzed in a correlation matrix to analyze if there are any county level variables that are affecting the numbers of non-natives of that family per county (Table 5). The only correlation coefficient that show significance is the relationship between the non-native Asteraceae and Poaceae ($r=0.444$, $p<0.01$).



A.

Figure 6 – Ratio of non-native to native species in selected counties. A. Poaceae, B. Fabaceae, C. Asteraceae, D. Brassicaceae, E. Lamiaceae



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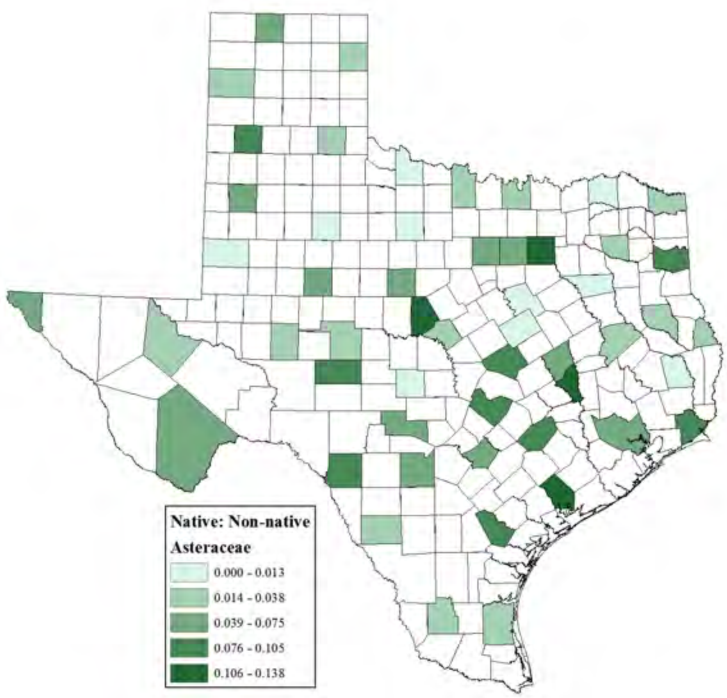
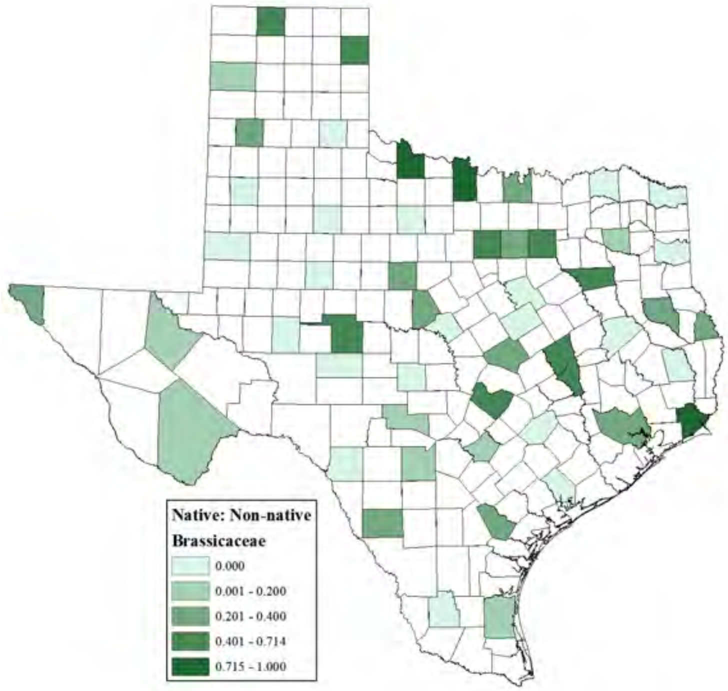
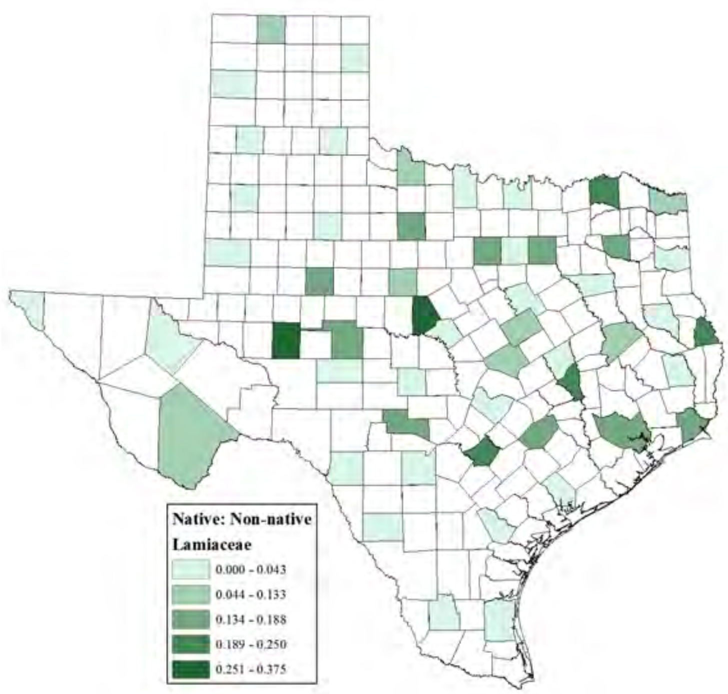


C.

Figure 6 cont. – Ratio of non-native to native species in selected counties. A. Poaceae, B. Fabaceae, C. Asteraceae, D. Brassicaceae, E. Lamiaceae



D.



E.

Figure 6 cont. – Ratio of non-native to native species in selected counties. A. Poaceae, B. Fabaceae, C. Asteraceae, D. Brassicaceae, E. Lamiaceae

Table 5 – Correlation matrix identifying variables that play a role in the distribution of ratios of non-natives to native species in the five largest species rich families of non-natives. Population density represents human population density, (* $p<0.05$, ** $p<0.01$)

	Asteraceae	*Brassicaceae*	*Fabaceae*	*Lamiaceae*	*Poaceae*
Asteraceae	1				
Brassicaceae	-0.04631	1			
Fabaceae	-0.06427	-0.15559	1		
Lamiaceae	0.16420	-0.13407	-0.02718	1	
Poaceae	-0.44495*	-0.12403	-0.13253	-0.17251	1
Area	0.00021	-0.01024	-0.03699	0.02746	-0.09290
Population Density	-0.01548	0.03259	0.08607	0.08313	-0.23414
Cropland (% of area)	-0.02523	0.16673	-0.17376	-0.14886	0.06996
Farmland (% of area)	0.15345	0.10124	-0.25894	-0.00225	0.24258
Precipitation (cm)	-0.23877	-0.15428	0.26267	-0.00077	-0.04293
Latitude	-0.20689	0.29695*	-0.15788	-0.23902	0.13408

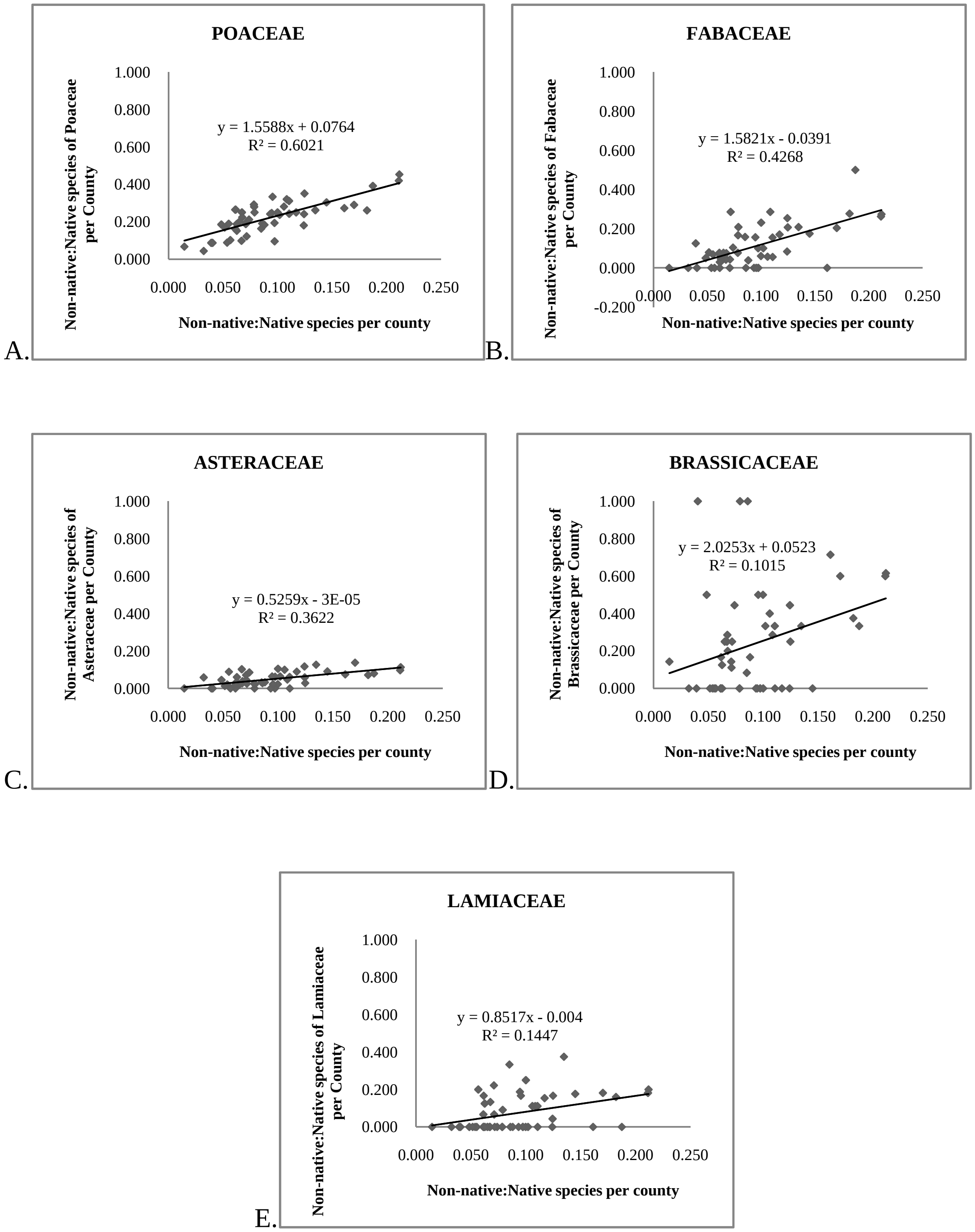


Figure 7 – Scatterplot showing proportions of non-native to native species of five largest families to total non-native to native species in the selected counties. A. Poaceae, B. Fabaceae, C. Asteraceae, D. Brassicaceae, E. Lamiaceae.

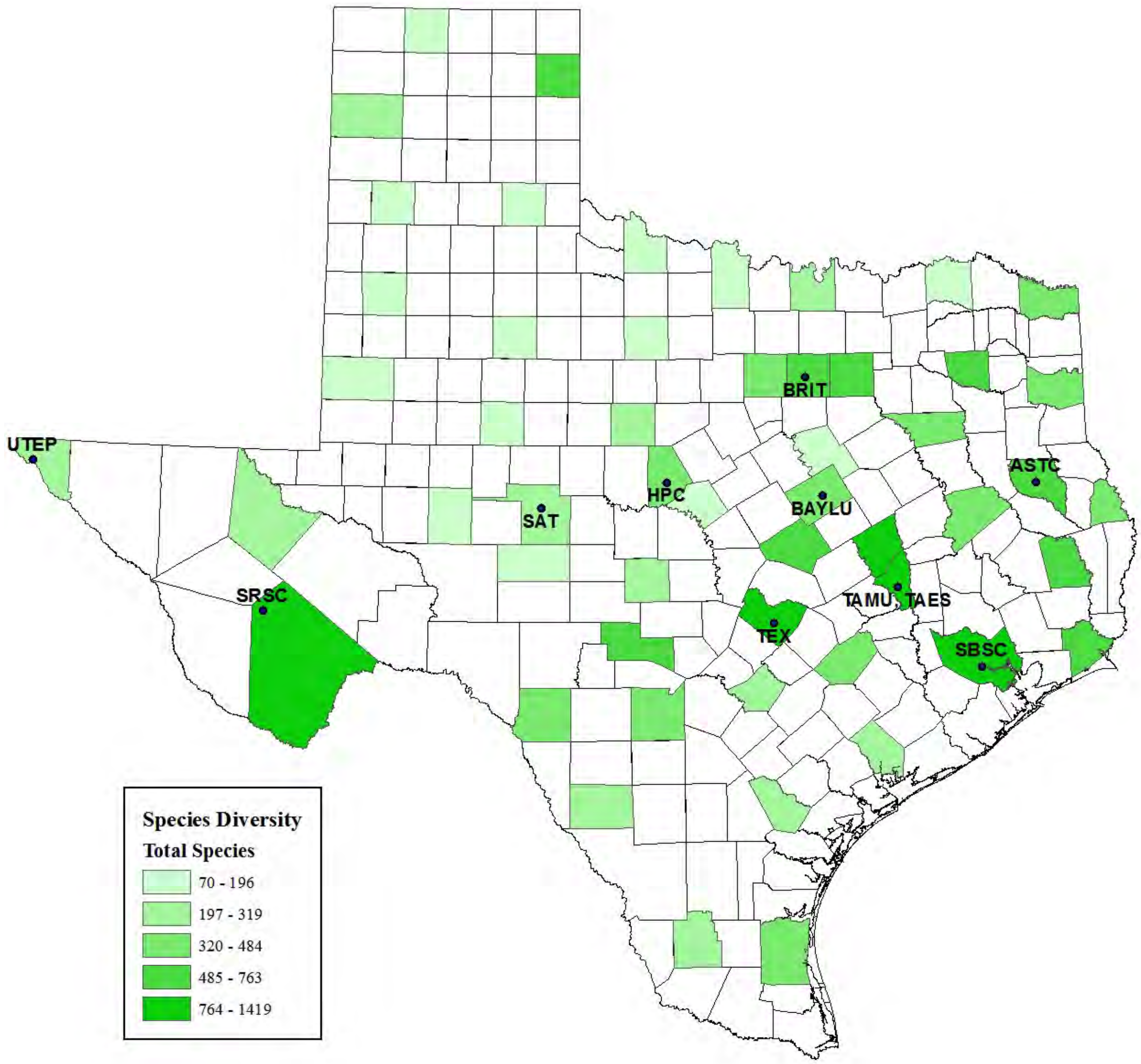


Figure 8 - The counties showing locations of major herbaria and species diversity.

The Botanist Effect in Texas

The ten counties with herbaria showed significantly higher plant diversity (total species) than the other counties containing no herbaria ($p<0.001$) (Table 6, Figure 8). There were 43 counties in the dataset without a herbarium. The counties with a herbarium also had a much higher average population density (216.88 people/km^2) than the other counties (35.0 people/km^2). The one notable county with no herbarium that had high plant diversity is Robertson County (118 non-native, 955 native, 1073 total species, 7.14 people / km^2). However, this county shares a border with Brazos County that is the home to two large herbaria (TAMU, TAES).

Table 6 – Data of counties with herbaria and counties without herbaria. Mean of species diversity (non-native, native, total), area, population density and precipitation to show the difference between the groups

	Non-native Species	Native Species	Total Species	Area (km^2)	Population Density	Precipitation (cm)
With Herbarium (*n*=10)	96.10	657.30	753.40	4152.80	216.88	75.57
Without Herbarium (*n*=43)	26.60	299.60	326.21	2750.16	35.00	77.53

Texas County and United States Non-native Flora Analysis

The data for the 53 counties selected are included as appendix A. The numbers of native and non-native species in each of the counties selected from the state is presented in Figure 9 and 10. These two figures reveal that the distribution of native and non-native species is very similar. The non-native species density is presented in Figure 11 to correct for the difference in area of the counties and shows how areas with high non-native species density are the counties with high numbers of non-native species except for Brewster County. The number of non-native species in the 53 selected counties range from 1 in Kent County to 231 in Travis County. The mean of non-native species of the sample is 39.72 with a standard deviation of 48.16. There are three counties outside of 2 standard deviations: Harris, Brazos and Travis. The county data for the numbers of species, both native and non-native is from the USDA Plants Database (USDA, NRCS 2009).

The factors used as potential predictors of the number of non-native species included: native species, total human population, county area, human population, farm land percentage of total county area, crop land percentage of total county area, precipitation, latitude, longitude and natural ecoregion. Ecoregion was used as a dummy variable unlike the other variables because it has no quantitative value to use in the analysis. All of the variables selected were included in a correlation matrix to determine if any of these were correlated and therefore should be eliminated because autocorrelation among predictors or the independent variables violate the assumptions of regression and ANOVA (Table 7). The dependent variable, non-native species, is highly correlated with both native and total species in the correlation matrix ($r > 0.80$, $p<0.01$). Longitude was omitted because of the correlation with precipitation (r=0.955, $p<0.01$) and total species richness was omitted because it is highly correlated with native species (r=0.997, $p<0.01$). Human population and human population density are also highly correlated (r=0.9424, $p<0.01$), so human population will be used instead of human population density. Human population density encompasses two variables: area and human population. Even though many values on the correlation matrix were significant ($p<0.01$), all but longitude, total species and human population density will be included in the regression models. The

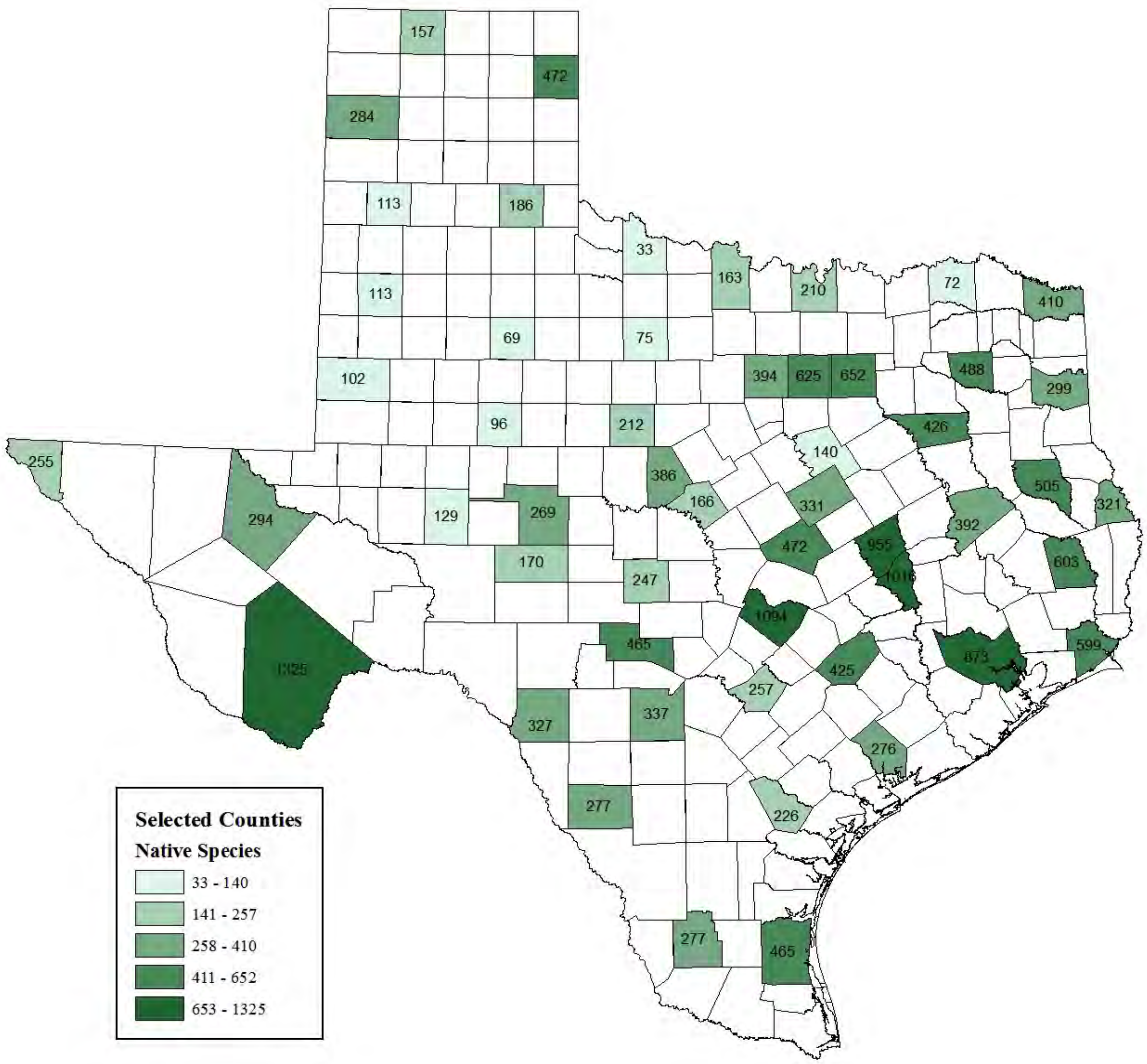


Figure 9 – Numbers of native species in the selected counties (USDA, NRCS 2009).

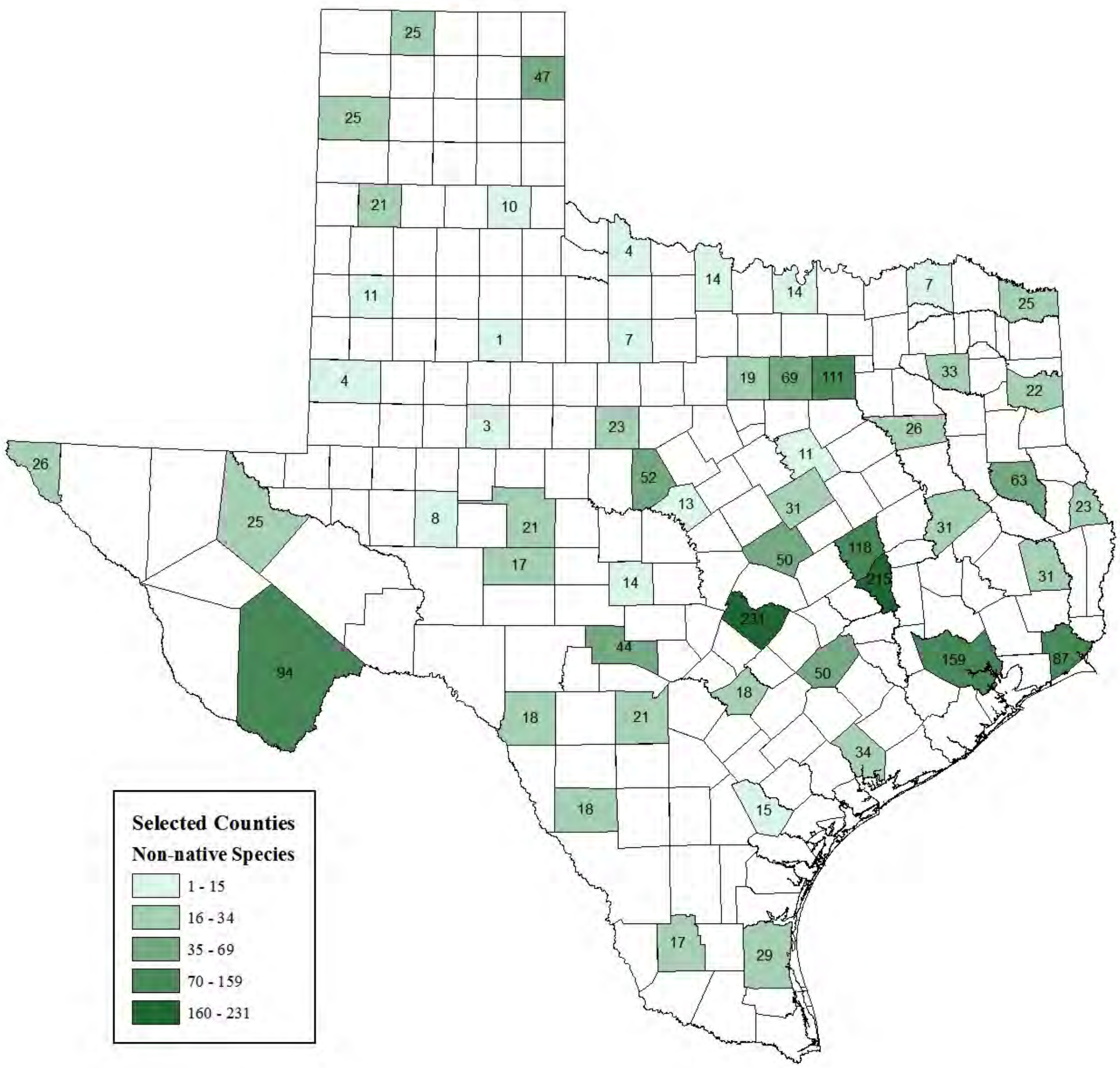


Figure 10 – Numbers of non-native species in the selected counties (USDA, NRCS 2009).

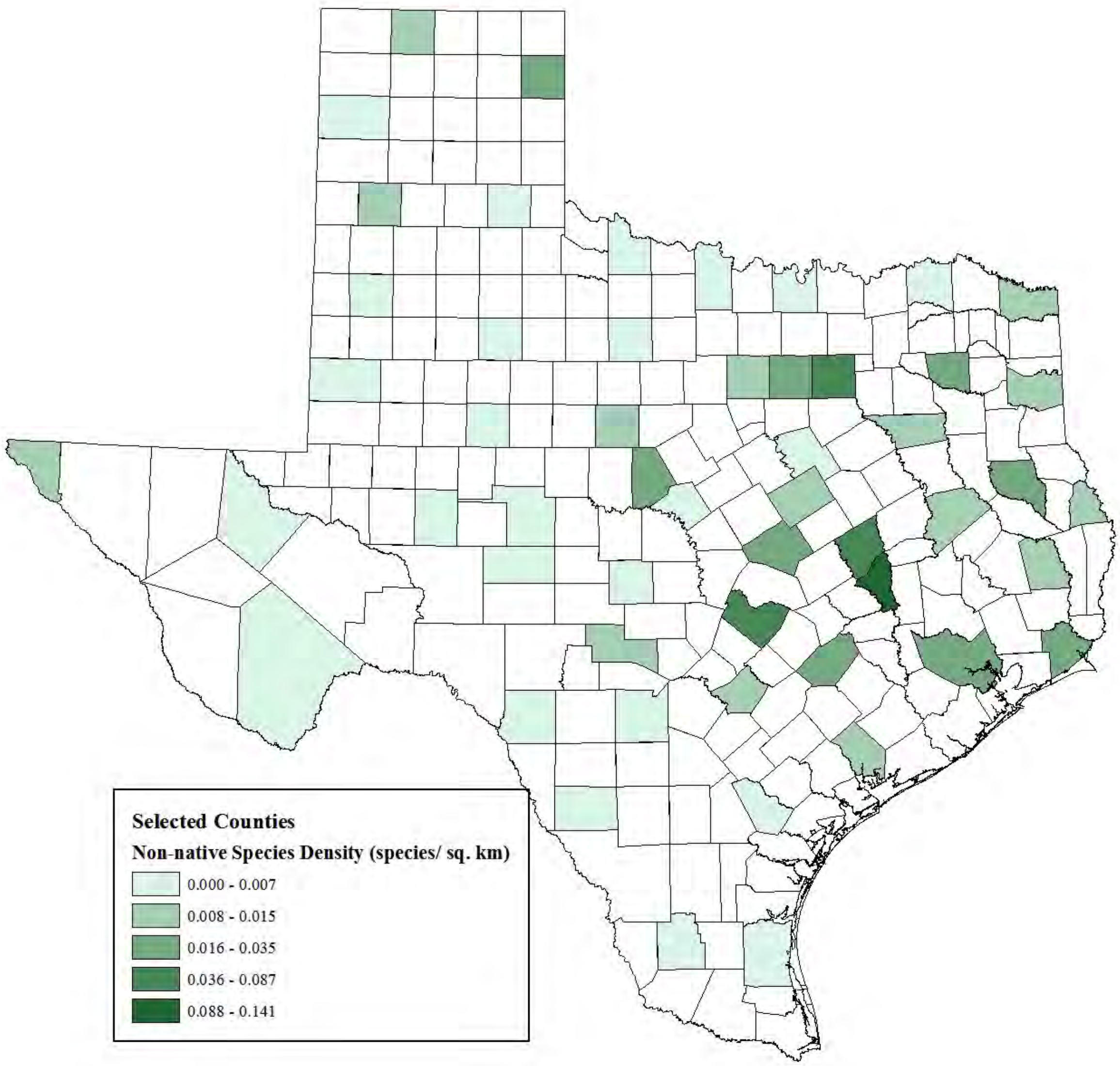


Figure 11 – Non-native species density (species/km^2) for the selected counties.

regression models will illustrate the relationship between the variables and non-native species. The multiple regression models were run with the remaining factors (native species richness, area, human population, farm area percentage, crop area percentage, precipitation and latitude) using the statistical software R (R Development Core Team 2005) (Table 8). The variables were entered in the models in different orders and the results turned out to be the same. The first multiple regression model was run with all independent factors (R^2=0.842) (Table 8A) and native species, area and human population showed statistical significance (p<0.001). This same regression model was run without native species because non-native and native species have a high correlation coefficient (r=0.8608, Table 7) and human population displayed statistical significance (p<0.005). This model accounts for 27.3 percent of the variability in non-native species (R^2=0.273, Table 8B). Another regression model was run with these three variables (native species, area, population) and all three variables again exhibited statistical significance (Table 8C). Each of the significant variables were run as a simple linear regression with non-native species and only native species and human population were statistically significant (p<0.001, Table 8D-F). Individually, native species account for more variability in the numbers of non-native species (R^2=0.741) than human population (R^2=0.280) and area (R^2=0.015). A scatter plot of the log-transformed values of non-native and native species shows the strong correlation between the two (R^2=0.818, p<0.001) (Figure 12).

Many counties contained one or more ecoregions (Figure 2B) and in the analysis the ecoregion with the most area in a county was used as the ecoregion representative of that individual county. This along with the number of ecoregions

Table 7 – Correlation matrix of the independent variables from the county data (Appendix). The *r* values of the variables with the underlined values showing the significant values. Population and population density represent human populations (* $p<0.05$, ** $p<0.01$).

	Non-native species	*Native species*	*Total species*	*Population*	*Area*	*Population Density*	*Cropland (% of area)*	*Farmland (% of area)*	*Precipitation*	*Latitude*	*Longitude*
Non-native species	1										
Native species	0.8608**	1									
Total species	0.8977**	0.9970**	1								
Population	0.5291**	0.4029**	0.4294**	1							
Area	0.1213	0.4332**	0.3935**	0.0276	1						
Population Density	0.5289**	0.4057**	0.4319**	0.9424**	-0.0266	1					
Cropland (% of area)	-0.2133	-0.3837**	-0.3647**	-0.1646	-0.1557	-0.1782	1				
Farmland (% of area)	-0.4324**	-0.5601**	-0.5508**	-0.5344**	-0.1341	-0.5724**	0.4320**	1			
Precipitation	0.2766*	0.3105*	0.3110*	0.1850	-0.3152*	0.1722	-0.2396	-0.5220**	1		
Latitude	-0.2136	-0.3043*	-0.2960*	-0.0719	-0.1921	-0.0224	0.4076**	0.1504	-0.1647	1	
Longitude	0.2612	0.2679	0.2718	0.1720	-0.3709**	0.1596	-0.2545	-0.4192**	0.9545**	-0.2133	1

Table 8 – Results from the regression analyses. Data were run in various orders with no difference in results. Non-native species is the dependent variable in each regression model. A-C – Multiple regression models. D-F – Simple linear regression models. Significance: (‘*’ 0.05, ‘**’ 0.01)

A. All of the independent variables from the county data (Appendix A) (Adjusted R^2=0.861).

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1.9648	50.9876	0.0385	0.9694
Native Species	0.1887	0.0130	14.4802	1.4988E-18**
Human Population	1.7680E-05	5.1697E-06	3.4199	0.0013**
Area	-0.0085	0.0016	-5.2114	4.5362E-06**
Cropland (% of area)	24.2804	14.7410	1.6471	0.1065
Farmland (% of area)	24.2148	14.5941	1.6592	0.1040
Precipitation	-0.2118	0.1284	-1.6495	0.1060
Latitude	-0.5019	1.3687	-0.3667	0.7156

B. All of the independent variables excluding native species (Adjusted R^2=0.273).

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	91.0232	119.0959	0.7643	0.4486
Human Population	3.7149E-05	1.1746E-05	3.1628	0.0028**
Area	0.0033	0.0033	0.9890	0.3278
Cropland (% of area)	-0.2958	34.4544	-0.0086	0.9932
Farmland (% of area)	-10.2812	33.8788	-0.3035	0.7629
Precipitation	0.3353	0.2888	1.1612	0.2516
Latitude	-2.7423	3.1998	-0.8570	0.3959

C. The regression model with human population, area and native species as independent variables (Adjusted R^2=0.832).

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-2.1015	5.3229	-0.3948	0.6947
Native Species	0.1608	0.0123	13.0704	1.3660E-17**
Population (2000)	1.3869E-05	5.1820E-06	2.6764	0.0101*
Area (km2)	-0.0066	0.0015	-4.3618	6.6205E-05**

D. Native species as the independent variable (R^2=0.741).

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-15.8950	5.7226	-2.7776	0.0076
Native Species	0.1515	0.0125	12.0804	1.3996E-16**

E. Human population as the independent variable (R^2=0.280).

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	31.0518	5.9929	5.1815	3.79399E-06
Human Population	4.3498E-05	9.7672E-06	4.4535	4.6281E-05**

F. Area as the independent variable (R^2=0.015).

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	31.0398	11.9532	2.5968	0.0123
Area	0.0029	0.0033	0.8725	0.3870

was used to analyze the significance of ecoregions in predicting non-native species. The number of ecoregions was run as a dummy variable in the multiple regression model and there was no significance of the number of ecoregions contained in a county ($P>0.10$). Two ecoregions, Oak woods and prairies ($P=0.070$) and the Edwards plateau ($P=0.088$) showed statistical significance at the 10% level. Residual analysis was performed with the remaining factors to identify if there were any other factors could contribute to explaining the number of non-native species in each county (Figure 13). All of these residual plots showed no statistical significance. The slope of the human population residual plot had the highest slope and reveals there is a pattern of non-native species distribution related to the human population of a county.

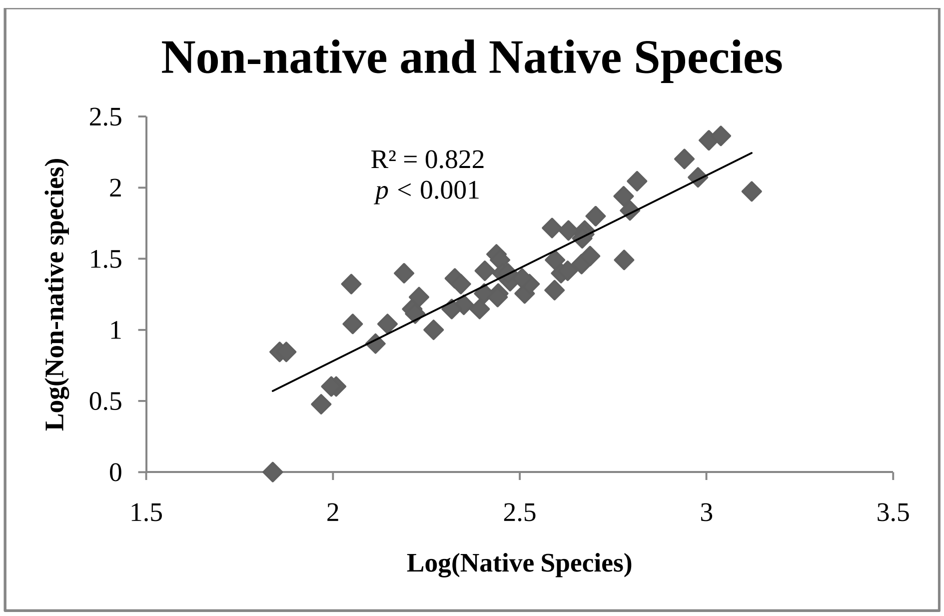


Figure 12 – Scatterplot of the log transformed non-native and native species data from the 53 selected counties.

The random patterns in the residual plots show that the best regression model to predict non-native species is a linear model. The number of native species is the best single variable for predicting non-native species and the other variables play a minor part in explaining the variability in the numbers of non-native species. The number of native

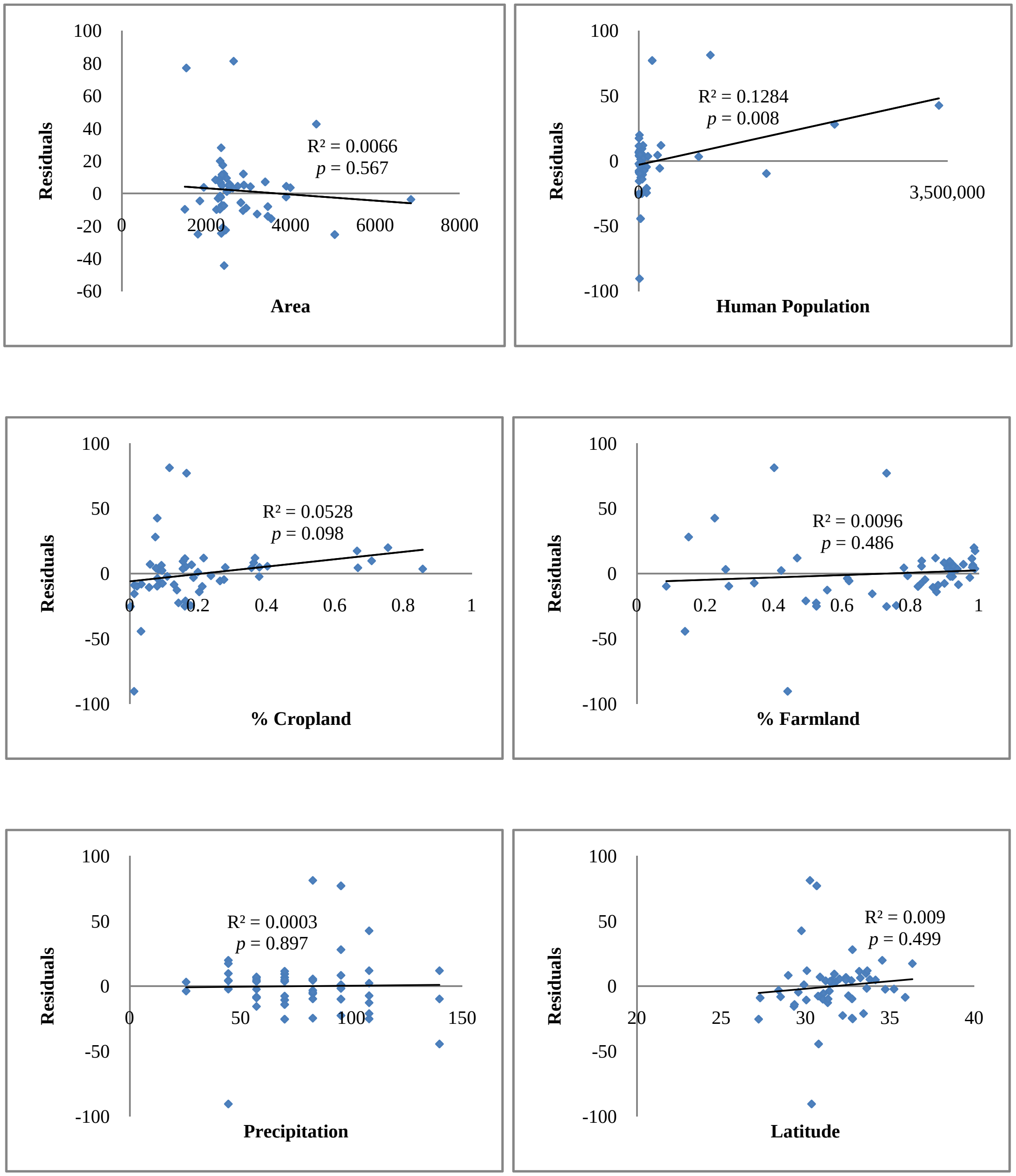
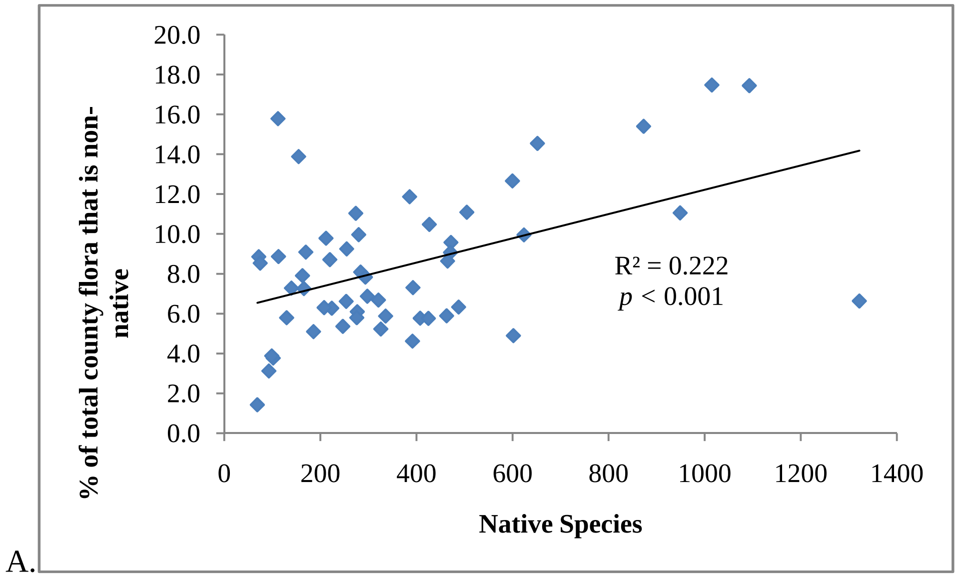


Figure 13 – Residual analysis from the regression model of native and non-native species.

species is also a good predictor for the percentage of a county's total flora that is non-native, because as the number of native species increases the percentage of non-native species in the county flora also increases (Figure 14A, $R^2 = 0.222$, $p<0.001$). However, the data from the United States exhibit the opposite pattern of numbers of native species and percentage of a state's flora that is non-native (Figure 14B, $R^2 = 0.174$, $p<0.001$). The native species account for 17.4 percent of the variability in the percentage of a state's flora being non-native. The scale and numbers of native species are much larger on the state level.

Texas is ranked 39th among the 50 states in percentage of non-natives in the total flora (Table 9) with 15.8 percent of its flora being non-native to the state. Texas is second in number of native species (Stein 2002), human population (U.S. Census 2009) and total land area (696,241 km^2). States that have been a part of the United States of America longer than others have a higher percentage of non-native species (Figure 15, $R^2=0.5327$). There are 26 states that joined the Union before Texas and all of these states have a higher percentage of non-native species. The states that joined Texas during the same year or after Texas became a state have varied percentages of non-native species. Hawaii has been excluded from this graph because it is a major outlier and its biogeography as an island makes it very vulnerable to non-native species introductions.

The states in the northeastern part of the United States have high percentage of non-native species in their flora (Figure 16). All of the states east of Texas have higher percentages of non-natives and all these states joined the Union before Texas. Precipitation shows significance in the regression analysis with non-native species



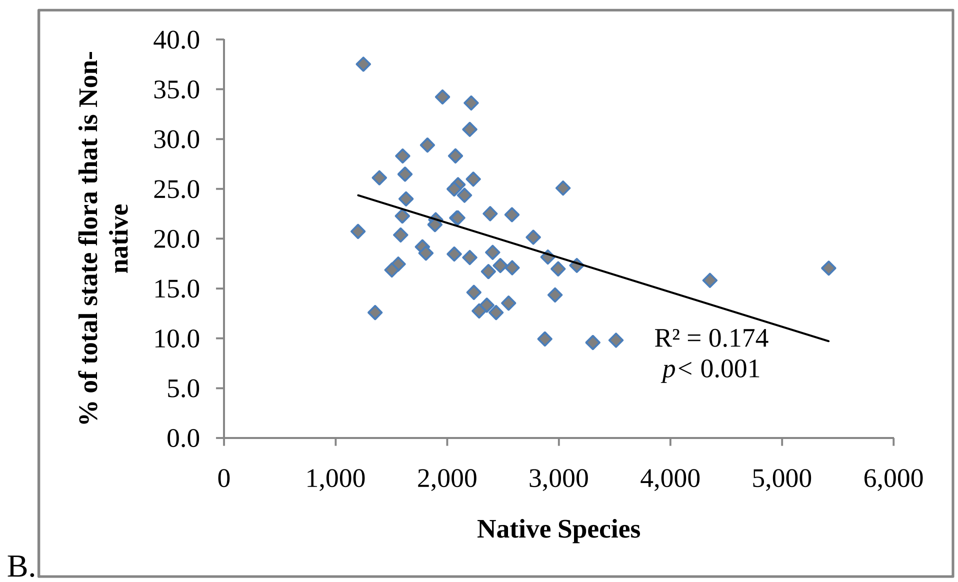


Figure 14 – The relationship of the percent of the total flora being non-native to number of native species in the selected counties (A) and States (B).

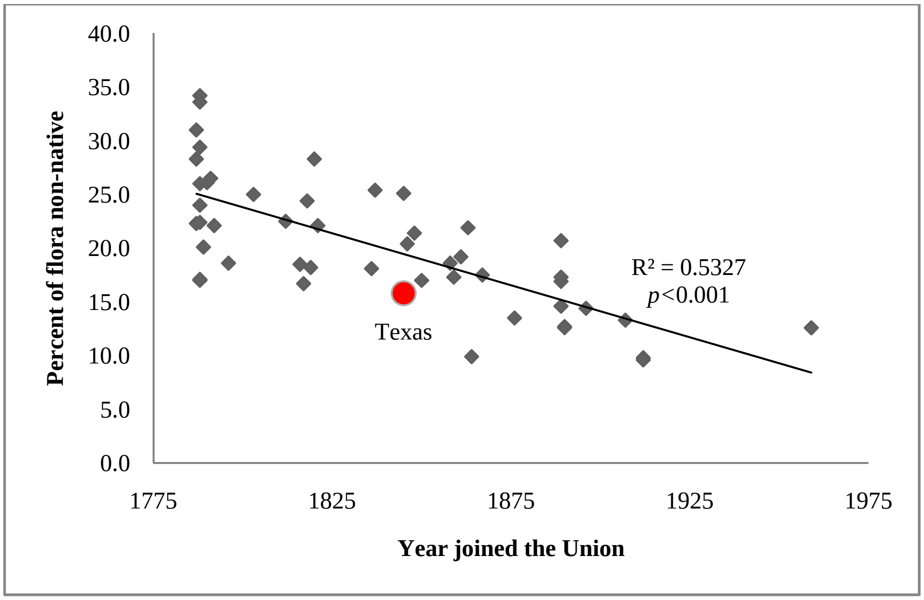


Figure 15 – Timeline of states joining the Union to the percentage of a state's flora that's non-native (excluding Hawaii).

(Table 10, *p<0*.005). The distribution of non-native species throughout the country generally follow the pattern of average annual precipitation (Figure 17) except that the states with the highest percentages are in the northeast, but the average annual precipitation is higher in the southeastern states.

The data from all of the fifty United States were run through a multiple regression model with similar variables as the selected counties (native species, human population, human population density, area, cropland percent of total area and precipitation) to understand the distribution of non-native species. Several factors showed significance in predicting the non-native species in the states (Table 10). All of the variables combined accounted for 84.4 percent of the variability in non-native species which is a similar pattern found in the Texas county data (Table 8). Human population (Table 10B had the highest R^2 value (0.555) in a linear regression model.

Table 9 – List of states with native and non-native species adapted from Stein 2002 and Mac et al. 1998. Ordered by the percentage of non-native species in the flora. Texas is bold and the data is from Turner et al. 2003 and current research.

State	Native Species	Non-native Species	Total Species	% Non-native	State	Native Species	Non-native Species	Total Species	% Non-native
Hawaii	1,249	750	1,999	37.5%	Kansas	1,778	422	2,200	19.2%
Massachusetts	1,958	1,019	2,977	34.2%	Tennessee	2,407	551	2,958	18.6%
New York	2,215	1,122	3,337	33.6%	Minnesota	1,809	412	2,221	18.6%
Pennsylvania	2,202	988	3,190	31.0%	Indiana	2,063	467	2,530	18.5%
Connecticut	1,823	759	2,582	29.4%	Alabama	2,902	644	3,546	18.2%
New Jersey	2,074	819	2,893	28.3%	Arkansas	2,202	487	2,689	18.1%
Maine	1,601	632	2,233	28.3%	Nebraska	1,561	330	1,891	17.5%
Vermont	1,622	584	2,206	26.5%	Oregon	3,161	662	3,823	17.3%
Rhode Island	1,392	492	1,884	26.1%	Washington	2,476	518	2,994	17.3%
Maryland	2,234	784	3,018	26.0%	South Carolina	2,582	532	3,114	17.1%
Michigan	2,097	715	2,812	25.4%	California	5,418	1,113	6,531	17.0%
Florida	3,038	1,017	4,055	25.1%	Georgia	2,994	612	3,606	17.0%
Ohio	2,062	687	2,749	25.0%	South Dakota	1,504	305	1,809	16.9%
Illinois	2,155	694	2,849	24.4%	Mississippi	2,369	475	2,844	16.7%
New Hampshire	1,631	515	2,146	24.0%	**Texas**	**4,354**	**817**	**5,172**	**15.8%**
Louisiana	2,385	693	3,078	22.5%	Montana	2,239	383	2,622	14.6%
Virginia	2,580	745	3,325	22.4%	Utah	2,966	497	3,463	14.4%
Delaware	1,598	458	2,056	22.3%	Colorado	2,550	399	2,949	13.5%
Missouri	2,095	594	2,689	22.1%	Oklahoma	2,355	362	2,717	13.3%
Kentucky	2,085	591	2,676	22.1%	Wyoming	2,286	334	2,620	12.7%
West Virginia	1,897	532	2,429	21.9%	Alaska	1,354	195	1,549	12.6%
Wisconsin	1,890	515	2,405	21.4%	Idaho	2,438	351	2,789	12.6%
North Dakota	1,201	314	1,515	20.7%	Nevada	2,875	317	3,192	9.9%
Iowa	1,583	405	1,988	20.4%	Arizona	3,512	382	3,894	9.8%
North Carolina	2,771	699	3,470	20.1%	New Mexico	3,305	350	3,655	9.6%

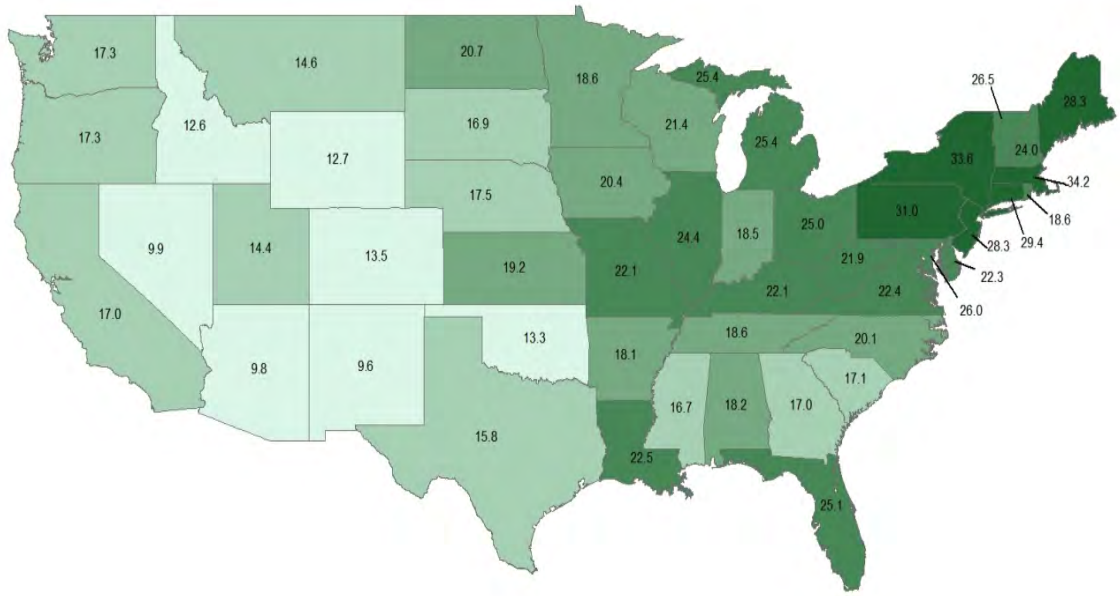


Figure 16 – Percentage of non-native species in the total flora in each of the 48 contiguous states with data from Table 8.

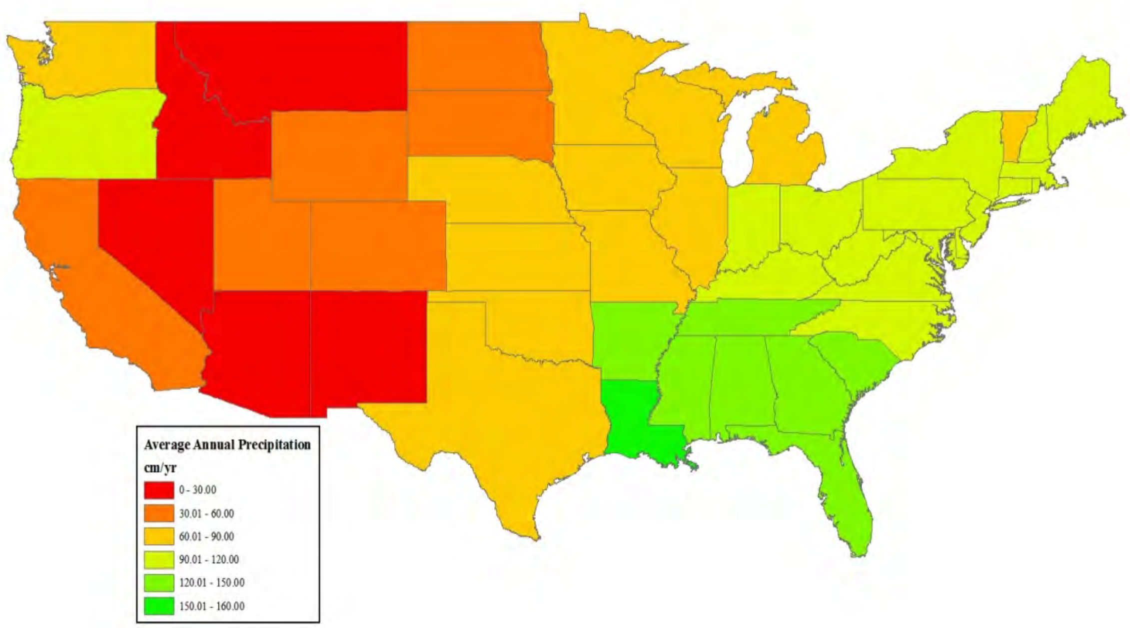


Figure 17 – Map of the United States showing the average annual precipitation of each state.

Table 10 – Regression model results from the states data. Significance: ('*' 0.005, '**' 0.001)

A. Multiple regression with all of the independent variables (Adjusted R^2= 0.844)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	537.8530	91.6160	5.8707	5.6358E-07
Native Species	-0.0648	0.0293	-2.2112	0.0324
Human Population	3.2200E-05	3.4091E-06	9.4454	4.7381E-12**
Human Population Density	0.1778	0.1667	1.0665	0.2922
Area	-0.0003	5.4553E-05	-4.6826	2.8419E-05**
Cropland % of total area	-346.7404	84.4022	-4.1082	0.0002**
Precipitation	1.2900	0.3795	3.3995	0.0015*

B. Human population as the independent variable (R^2=0.555)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	432.0999	28.4601	15.1827	5.9134E-20
Human Population	0.0000	0.0000	7.7304	5.6401E-10

C. Area as the independent variable (R^2=0.069)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	626.0519	38.6297	16.2065	4.2579E-21
Area	-0.0002	0.0001	-1.8894	0.0649

D. Cropland % of total are as independent variable (R^2=0.051)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	636.8734	46.4553	13.7094	3.2248E-18
Cropland % of total area	-269.6848	168.1083	-1.6042	0.1152

E. Native species as the independent variable (R^2=0.122)

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	351.7045	93.6269	3.7564	0.0005
Native Species	0.0997	0.0387	2.5780	0.0131

CHAPTER IV

DISCUSSION

Synthesis of the Non-native Flora of Texas

There are 817 non-native plant species found in the state of Texas. This constitutes 15.8 percent of the total vascular flora of Texas (Table 1). The non-native flora is comprised of 104 plant families of which 11 are composed of entirely non-native species. The presence of non-native species is directly and indirectly associated with human disturbance. Non-native species arrived in the state both intentionally and accidentally. People bring in plants that are useful for food (*Solanum lycopersicum*, *Spinacia oleracea, Coriandrum sativum*, etc.) and ornament (*Catharanthus roseus, Caesalpinia gilliesii, Lagerstroemia indica,* etc.) and many species come in as contaminants in seed or on nursery plants (*Medicago* spp., *Emilia fosbergii, Pilea microphylla,* etc.). The non-native species of Texas have arrived in the state in a variety of ways.

There are several non-native species that have been collected only from a single county and may not have been collected in Texas for many years (e.g. *Indigofera hirsuta, Ipomoea cairica*, *Ludwigia peruviana*). This raises the question "When should a non-native species be included in or excluded from the total flora?" For the purposes of this study, non-native species should be included in floristic accounts where they have been discovered. In addition, information should be provided about how far along they are in the invasion process. For example, a non-native species that was collected in one location 30 years ago should be included a flora with the explanation that it was collected once in the state and has not been collected for 30 years. There are many non-native species that need further research, such as the 131 plant species for which a voucher specimen was not found during this project (Table 2). These species either were reported without the collection of a voucher specimen (Hatch pers. comm.) or the voucher was not found in herbaria searched for this project. Species lists and floras should indicate whether a plant species is cultivated or naturalized and to what extent the plants have spread. Herbarium specimen labels should include estimates of how many individuals are present, how large an area the population covers and if and how population is reproducing or spreading. Plant collectors need to be more thorough in recording collection data. Further study of the vouchers of the non-native species may reduce the number of non-native species in the state because data is insufficient on some to determine the non-native status of the species.

Authors of various floras differ in their use of terminology and listing of non-native species (Nesom 2000, Pysek et al. 2004). There needs to be more standardization in terminology and classification of the non-native floras of the world. This study has used standard terminology for non-native plants based on several other sources (Nesom 2000, Richardson et al. 2000, Pysek et al. 2004). "Non-native" should be the general term for species that are not native to an area with sub classification to "cultivated," "casual alien" and "naturalized" The term "invasive" should be used for naturalized species that have a negative impact on the environment and/or the economy. The study of non-native species can be important in understanding the change of composition of a flora and more emphasis needs to be put on collecting and research on individual species.

Timeline of Non-native Species Discovery

The timeline of non-native species discovery in Texas is presented in Figure 3 (10-year intervals and 25 year intervals). The 10-year interval graph shows the peaks of discovery of non-native species in the state (Figure 3A). There are two large peaks during the decades of 1931-1940 and 1961-1970. These peaks correspond with the 10-year time period prior to the publication of two major works in the Texas flora: Cory and Parks (1937) and Correll and Johnston (1970). The average number of new non-native species discovered per decade is 68.08 with a standard deviation of 37.32. The large standard deviation illustrates the variation among the decades, with only the large peak (1931-1940) being significantly greater than the mean because it falls outside two standard deviations above the mean. In the 120 years (1850-1970) leading up to Correll and Johnston's Manual of the Vascular Flora of Texas (1970), 591 non-native species (72.3 percent of total non-native flora) were discovered and reported in the state. This is a very large percentage and within the last 40 years there have been 226 (27.7 percent of total non-native flora) more non-native species found in the state. There has been a general trend of non-native species discovery increasing to the peak during the interval of 1926-1950 and declining since then (Figure 3B). This downward slope does not indicate an increase in introduction of non-native species even though there is more national and international travel into the state.

These patterns in plant introductions (Figure 3) are not a precise representation of when species were introduced or naturalized because the dates correspond with the earliest publication mentioning a species and may be only a representation of when there was more intense collecting pressure. The number of new non-native species discoveries in the state more than doubled from 1921-1930 to 1931-1940 (from 69 to 156 species) and from 1951-1960 to 1961-1970 (from 49 to 118 species). The work of Cory and Parks (1937) and Correll and Johnston (1970) were based on intense plant collecting which led to the discovery of new species, native and non-native, in the state. The analysis of voucher specimen dates does not give a precise timeline of non-native species introductions into the state. These data are from scientists and other individuals who are out collecting plants and taking notes to identify species. This data may only be an approximation of introductions and more research needs to be done to better identify dates and pathways of introductions and naturalization of non-native species.

Geographic Origins of Non-native Species in Texas

The origins of the non-native flora of Texas are similar to those of many other non-native floras in the New World in that they originated primarily from the Old World (594, 72.6 percent) (di Castri 1989, Pysek 1998a, Villaseñor and Espinosa-Garcia 2004). This can be attributed to the large number of immigrants and human migration events from these areas as well as the similarities in climate. Non-native plant species are generally successful in areas that have a similar climate to their native geographical range. Mexico similarly has a high percentage (78 percent) of non-natives originating in the Old World (Villaseñor and Espinosa-Garcia 2004).

Many of the species originating from Old World have been associated with humans for many centuries. This has selected plant species that have evolved to take advantage of the disturbances created by man. The largest percentage of non-native species originated from Eurasia which is a large area that has many climates. This has led to many species being adapted to a wide range of climates and many species from Eurasia successfully adapting to the diverse climates in Texas.

South American and Neotropical plants also contribute a comparatively high number of non-native species (Table 3), 102 (12.5 percent) and 85 (10.4 percent of total non-native plants), respectively. This is due to these species geographic origin being nearby Texas and the large number of immigrants from these areas.

Species originating from North America outside of Texas make up only 1.8 percent of the total number of non-native species (Table 3). Texas is a large state and includes several different ecoregions of the country and this is why species originating from elsewhere in North America are such a small percentage of the Texas non-native flora. There are many eastern and western North American species found in their respective areas of the state (MacRoberts and MacRoberts 2003). Some North American species that are not known to be native to Texas have been used as ornamentals (*Robinia pseudoacacia, Liriodendron tulipifera*) and also been grown in the state as timber (*Pinus elliottii)*. A North American plant species, *Eschscholzia californica,* native to California and western states has been introduced into Texas and also other countries with similar climates and has become an invasive species outside of North America (Leger and Rice 2003). There is a need for research to determine if some of these North American species may have been native to the state or began growing here without human intervention.

Plant species originating from tropical areas such as Oceania and Pantropical areas also make up a small percentage of the non-native flora of Texas (1.8 and 1.5 percent of the total non-native species, Table 3). These areas are poorly represented because the climates these species come from are milder than climates in Texas. Many of these species are found areas of the state along the Gulf Coast and southern part of the state where the climate is milder than in other areas of the state.

The timelines of introduction of the species based on their geographic origin (Figure 4) show several patterns similar to the general graph (Figure 3) of species introduction. The very large peaks that indicate a large number of species from many of the origins recorded during the decade from 1931-1940 may correlate with the research leading up to the publication of Cory and Parks (1937) state checklist of plants. The six peaks in Figure 5 and 6 appear to correspond mostly with the publication of two major works on the flora of Texas, Cory and Parks (1937) and Correll and Johnston (1970). There were several gaps of species introduction from plants originating from the regions with smaller numbers of species because there were fewer species being introduced and there may not have been any species collected in some time periods. The only geographical regions represented in every time period were Eurasia, Africa, South America, Neotropical and Eurasia. The larger peaks may not only have been from continued immigration of people and plants from that particular region of the world, but also from more intense plant collecting pressure during those periods.

The origins of non-native plant species helps in our understanding of how species were introduced into the state and which types of species can adapt to the climate of Texas. Species originating from Eurasia have an advantage over species from other areas because of their large geographical range and long association with humans. The pathways of introductions of non-native species into the state play a role in how these species naturalize in the state. However, the geographical origin of plant species does not necessarily determine how the plant species entered the state. For example, a species native to Africa did not necessarily enter the state directly from Africa, but could have come to Texas from another state that already had that species present. The majority of non-native species in Texas are also present in other states (USDA, NRCS 2009). Several non-native species (e.g. *Paliurus spina-christi*, *Nomaphila stricta*, *Cyperus phaeolepis*) have been found only in the state of Texas and may have been introduced into the United States directly through Texas. Others are found in scattered localities, such as *Erodium malacoides* (Lemke and Aplaca 2006) which has been reported from Massachusetts, New York and California along with Texas. The origins of species can be important in determining if a species will become naturalized and potentially invasive in a new area with similar climate.

Analyses of the Five Largest Families of Non-natives Species

The largest plant families in the Texas non-native flora are the same as in the non-native flora throughout the world (Table 4). Poaceae, Fabaceae and Asteraceae make up 36.4 percent of the total non-native Texas flora. These three families are in the top five families worldwide in terms of total numbers of species and have a variety of characteristics that make them successful non-natives (Heywood 1989, Pysek 1998a). The large number of species in each family contributes to the high numbers of non-natives in the state of Texas.

Poaceae has a specialized inflorescence and pollination strategy. This family also has adapted to a wide variety of habitats. Many species of grasses have been introduced into the state as grain, pasture or fodder crops and have escaped to become naturalized which has led to the large number of non-native grasses in the state. Fabaceae is a family with diverse habits from tiny annuals to large trees that have been very effective in attracting pollinators. Many species in this family can also fix atmospheric nitrogen becoming very efficient in low nitrogen soils. These two families both had high slopes and relatively high R^2 values compared to the other three large families in relation to the proportion of non-natives in county level floras (Figure 7). As the number of total non-native in each county increased, the number of Poaceae and Fabaceae would have increased 1.5 times. These two families make up a large part of the total non-native flora of the world and of Texas because of their exploitation and usefulness as cultivated plants to humans.

The family Asteraceae is also a very specialized family. The Asteraceae have very reduced flowers and have a geitonogamous breeding system. They also have extremely effective means of seed dispersal such as capitular scales, wings, tubercles, hooks, pappus, bristles and parachutes (Heywood 1989). The diverse habit, effective seed dispersal and the presence of phytochemical defenses make the Asteraceae a successful invasive family. Cronquist (1988) attributes the success of the Asteraceae to its chemistry more than its morphology. It is the largest family in the world in numbers of species, however there is a lower percentage of non-native Asteraceae in Texas than represented in world floras (Pysek 1998a). This may be in part to the high numbers of Asteraceae already native to Texas (620, Hatch et al. 1990) which might exclude exotic species from filling niches that are taken by other species of Asteraceae. The Asteraceae have the lowest slope out of the five families in Figure 7 indicating that there are lower proportions of non-native to native species of Asteraceae than in the total flora of each of the selected counties, but it is positively correlated with the total native to non-native species in each county. This family is known to be more prevalent in temperate or subtropical and not densely forested areas (Cronquist 1988). Much of Texas is historically open savannah, prairie and desert, so this may account for the large number of native species of Asteraceae. There was an increase of the proportion native to non-native species in each of the 5 largest families as the overall proportion of non-native to native species in the total flora of each county increased (Figure 7). This illustrates the proportion of non-native species in each of these families has the same basic pattern. All five of these families show diversity in their habits, being very adaptable to many niches and able to disperse effectively that make them successful invaders. Several species such as *Poa annua* (Poaceae), *Trifolium repens* (Fabaceae), *Taraxacum officinale* (Asteraceae) and *Capsella bursa-pastoris* (Brassicaceae), have coexisted with humans for many years and have been able to adapt to the plethora of disturbances that human activity creates.

Patterns of the distribution of these five families across Texas were used to identify areas that may be more susceptible to invasion by different types of non-native species. Ratios of non-native to native plant species for the five largest plant families, based on numbers of non-native species, were mapped (Figure 6) to identify any patterns of distributions of these families. The Poaceae, Fabaceae and Asteraceae are large families with diverse habits and are found throughout the state. Species in Brassicaceae had higher proportions of non-natives in the north central areas of the state along with several areas in the eastern portion of the state. The three counties (Clay, Houston and Wilbarger) that have no native species of Brassicaceae may have been under-collected. This is a large enough family of plants that there should be several native species found in those counties. There are slightly higher ratios of Poaceae and Lamiaceae in the central portion of the state (Figure 6A, E). The data from the 53 selected counties was inconclusive and there were no strong correlates of distribution of specific families. All of the scatter plots shown in Figure 7 show the proportion of non-native to native of the five families to the ratios of total non-natives to natives in each county. The correlations are strongest in the larger families with R^2>0.35. The three largest native plant families also have the largest numbers of non-native species.

The graphs of the top five largest families in the state and the dates they were discovered are shown in Figure 5. These graphs show a constant pattern throughout with a large peak showing a period of greater introduction. Poaceae and Asteraceae both show the same pattern as the total non-native flora showing a large peak during the decade of 1931-1940. The others have various peaks that may correlate with discoveries of new introductions of non-native species during those times.

<u>The Botanist Effect in Texas</u>

Estimates of the relative proportion of non-native species may be influenced by a phenomenon called the "botanist effect" (Delisle et al. 2003, Moerman and Estabrook 2006, Pautasso and McKinney 2007). In this study the counties with herbaria show a higher species diversity and higher numbers of non-native species compared with counties with no herbarium present (Table 8). The counties with herbaria also had higher human population density than the other counties suggesting that it may be a higher human population density that affects species richness. I believe the botanist effect has made the data from this study hard to interpret because the data from counties with herbaria have a higher species richness and more non-native species. The botanist effect could be minimal if humans are concentrated in areas that have higher native plant diversity (Pautasso and McKinney 2007). This could be verified with more research on the native diversity of the counties by having a better representation of the flora collected and studied.

Brewster and Roberston counties provide two contrasting examples from the selected county subset with a human population density of 0.55 and 7.14 persons/km^2 respectively. Brewster County has the largest area and has the highest total species number of the 53 selected counties (1419 species). Brewster County is also the home of a large herbarium at Sul Ross State University (SRSC) in Alpine. Roberston County does not have a herbarium, but has the fourth highest species number (1073) of the 53 counties and does not have a large area (2242 km^2). Robertson County does border Brazos County which houses two large herbaria at Texas A&M University (TAES, TAMU). The counties including and surrounding Brazos County have been well collected by botanists and botany students collecting plants for herbarium or botany course collections (Reed 1997).

Many counties in Texas lack in-depth floras (Neill and Wilson 2001, Williams and Lutterschmidt 2006) and this causes many counties to demonstrate the lack of a botanist effect. More than 85% of the counties of Texas have documented species richness less than the values predicted from looking at herbarium records and regression analysis (Williams and Lutterschmidt 2006). Texas has the most counties of any state in the

United States (254) and is a large area to collect plants. For better understanding of the native and non-native flora of Texas, more floristic studies must be done focusing on the counties that may have not been botanized very well. One example of a county's flora that may not have been collected very well, based on the subset of Texas counties in this study, is Kent County in the panhandle of Texas. This county is listed as containing only 70 total plant species (USDA, NRCS 2009) with 69 natives and 1 non-native. The small population (859) (U.S. Census 2009) from the 2000 census may also be a part of the reason there is a low recorded species diversity in that county and why it is the lowest of the surrounding counties. Other nearby counties in the panhandle have more species diversity (Table 11) and those counties surrounding Kent county display a range of total species numbers from 413 in Garza County to the west and 77 in Stonewall County to the east. The size and climate of these counties are all very similar, but the human populations differ by a factor of 20. These numbers show that Dickens and Garza counties may have a better representation of the flora in that area. There are other factors that are affecting the numbers of plant species in the area, but the number of native species is still the most important factor in identifying how many non-native species will be present (R^2=0.918).

Table 11 – County data of counties surrounding Kent County.

County - vicinity to Kent Co.	Non-native species	Native Species	Total Species	Population (2000)	Area (km^2)
Kent	1	69	70	859	2339
Dickens - north	12	232	244	2762	2344
Stonewall - east	1	76	77	1693	2383
Garza - west	40	373	413	4872	2321
Scurry - south	8	95	103	16361	2352
Fisher - southeast	2	78	80	4334	2336

Our understanding of the non-native flora of Texas may be affected by the botanist effect and may not indicate as many non-native species as are actually present in the state. There may be more counties like Kent County with very little information and we do not know what the species diversity is in those counties. This is very a disappointing statistic that affects our understanding of both native and non-native species. This under-sampling may be due to a decline in field botanists and studies involving traditional taxonomy of plants (Isley 1972). Many counties or areas that have not been botanized may very well have interesting and rare native species with importance to humans. There may be larger numbers of non-native species that are found in counties not visited often by botanists and the non-native species problem may be more widespread than it seems with many of the non-native species centered on areas with high human population and high numbers of native species. With the help of other botanists and plant collectors, there needs to be increased collecting in counties farther from the major population centers. The collection and publication of new native and non-native species found should not only coincide with major publications, but always should always be on the increase. The data that may be collected throughout this large state can help us to better understand how extensive the range is of some of these non-native species.

Texas County and United States Non-native Flora Comparison

Texas' 15.8 percent non-native flora ranks it 39th out of the 50 states (Table 9). This is in contrast to other rankings such as number of native species, human population and area in which Texas ranks second out of the 50 states. The large size provides habitats for large numbers of native species, yet the numbers of non-natives are not correlated with size because Texas ranks seventh in number of non-native species (Table 9).

Although the 53 counties that were selected to predict non-native species in the state represent a small percentage of the counties of the state (20.9 percent), many interesting patterns were revealed. There are patterns of native and non-native species distribution throughout the counties (Figure 9 and 10). There are clearly areas of the state that have higher numbers of native species (Figure 9) and these counties also have high numbers of non-native species (Figure 10). All of the county-level independent variables (native species, area, human population, cropland percent of total area, farmland percent of total area, precipitation and latitude, and the number of non-native species) were run in a multiple regression model (Adjusted R^2=0.8612). The bivariate simple regression models that were run reveal that non-native species have the strongest positive correlation with the number of native species and account for 74.1 percent of the variability of non-native species (Table 21) in the regression models. This supports the observation that areas of high native species richness also have a tendency to have a high number of non-native species (Lonsdale 1999, McKinney 2001, Stohlgren et al. 2001, Stohlgren et al. 2003, Herben et al. 2004, Huston 1994, 2004, Pysek et al. 2004, Jarnevich et al. 2006). Studies have also shown plant species richness (native and non-native species) is correlated with human population size and density (McKinney 2001, Pautasso and McKinney 2007). Areas heavily populated by humans are often areas of high native species richness and these same factors favoring human habitation favor high non-native species richness (Huston 1994, 2004, Stohlgren et al. 2003, Jarnevich et al. 2006). This can be seen in Texas with counties such as Travis (1093 native species, 231 non-native species, 812,280 population), Harris (873, 159, 3,400,578), Dallas (652, 111, 2,218,899) and Tarrant (624, 69, 1,446,219) having high numbers of native and non-native species along with high human populations.

The ecoregions of Texas were also run in multiple regression models as dummy variables to determine if there were any ecoregions with higher rates of non-native species. Only two of the eleven ecoregions exhibited statistical significance (Edwards Plateau and Oak woods and prairies). The Edwards Plateau ecoregion is known for high native species richness and high endemism (Diamond et al. 1987) and this may help explain the higher predicted non-native species from the regression models. The oak woods and prairies region contains some of the counties with the highest population such as Dallas and Tarrant counties. There are also counties in this ecoregion that have some of the highest species richness from the subset of selected counties (Brazos, Robertson). There are correlations between these ecoregions and areas that are high in native species and also human population. This supports the observations that areas with higher native species richness and high human population also have higher numbers of non-native plants. Overall the dominant ecoregion in a county does not play an important role in determining the numbers of non-native species in the county. The factors that are most important in predicting these numbers are the number of non-native species and the human population.

The patterns in the Texas counties contrast with the patterns seen across all 50 states. Similar data were collected from the states as for the counties of Texas. Many states have diverse habitats which are consistent with the differences between the selected counties on a much smaller scale. The state data (Table 10) suggest that human population would be the best individual variable that can explain the distribution of non-native species (R^2=0.555). On a large scale, such as the entire U.S., the greater ranges of conditions provide a higher chance of explaining the variability of non-native species. Human population was used in place of human population density in the county data and this also was a significant factor in predicting the variation in non-native species among the states. On the county level in Texas, native species explains 74.1 percent of the variability in non-native species distribution while in the state data it is only 12.2 percent (Tables 8, 10). The variation in environmental conditions within a county is much less than at the state level and should better explain how non-native species are distributed throughout the landscape.

The percentages of county floras that are non-native in relation to the numbers of native species have the opposite pattern seen among the states (Figure 14). In the county data, as the number of native species increases the total flora percentage of non-native species also increases (R^2=0.222, $p<0.001$). However, among the states there is a decrease in the percentage of non-native species with an increase in number of native species (R^2=0.174, p<0.001). The difference between state and county data may be due to the scale of the measurements. Many of the states cover large areas that encompass many different biogeographical regions and the counties only include smaller more specific plant associations or habitats. The number of native species may be the best predictor for non-native species for the county level in Texas, but this predictor does not hold true for the state level data.

The states in the eastern part of the United States have a higher percentage of non-native species than Texas and this is partly due to the longer period of European and other immigrant settlement in those states (di Castri 1989, Heywood 1989, McKinney 2001). There appears to be a strong pattern in the United States of the older states that have been a part of the Union the longest having the highest percentage non-native species in their flora. All of the states older than Texas have higher percentages of non-natives (Figure 15). The time of human occupation (post Christopher Columbus) is apparently very important in how many non-native species are present in an area. The longer the period of immigration to an area the higher the number of non-native species. The date of settlement for the selected counties may also be important to explaining the number of non-native species. This information can be evaluated to identify if there is a pattern of older counties larger percentages of non-native species.

The number of native species in a county can be as used a guide to predicting numbers of non-native species. Many areas with higher native diversity also have higher non-native diversity (Pysek 1998a, 1998b, Lonsdale 1999, McKinney 2001, Stohlgren et al. 2001, Stohlgren et al. 2003, Herben et al. 2004, Huston 2004, Lockwood et al. 2007). If this holds true, then many of our most biologically diverse habitats are the most susceptible to invasion by non-native species and these areas need extra protection from destruction. There needs to be more herbarium work and species collection to identify if the non-native species already present in the state are “casual aliens” or “naturalized,” and also to identify what other species can potentially become “invasive.” There are already 31 species listed by the USDA (2009) as “noxious weeds” (e.g. *Eichhornia crassipes, Salvinia* spp., *Convolvulus arvensis*). The state website texasinvasives.org (2009) has a list of 142 invasive species present in and under the threat of entering the state. These lists are a beginning of a larger effort identifying non-native and potentially invasive species and there is a greater need to better document non-native plant species in the state of Texas. The history of the current non-native flora can help us understand how to manage for the prevention of the new non-native species being introduced into the state.

From the results of this study it is clear that there are large numbers of non-native species in the state and the non-native species are centered and highly concentrated in areas of high population density and native species richness. Since non-native species are associated with the activities of humans, many of our large metropolitan areas in the state are the vectors for new introductions of non-native species. Houston, Dallas, San Antonio and Austin are all culturally diverse (U.S. Census 2009) and many people bring culturally significant non-native plants species with them, purposefully or by accident. More vigilant work needs to be done by local botanists, horticulturists and agronomists to help prevent the spread of more invasive non-native plants by quickly identifying and eradicating new introductions into the state.

Appendix – Data collected for the 53 selected counties

County Name	Non-native Species	Native Species	Total Species	Population (2000)	Area (km^2)	Population Density (persons/km^2)	Cropland (% of area)	Farmland (% of area)	Precipitation (cm)	Latitude	Longitude
BEE	15	224	239	32359	2279.99	14.19	0.18623	0.97338	82.55	28.40556	-97.75083
BELL	50	472	522	237974	2817.73	84.46	0.26403	0.62037	82.55	31.05889	-97.46333
BOWIE	25	408	433	89306	2389.96	37.37	0.16290	0.49388	107.95	33.44139	-94.41972
BRAZOS	215	1015	1230	152415	1528.85	99.69	0.16607	0.72991	95.25	30.66555	-96.36675
BREWSTER	94	1322	1416	8866	16039.23	0.55	0.01264	0.44081	44.45	30.36083	-103.66556
BROWN	52	386	438	37674	2478.47	15.20	0.15567	0.91448	69.85	31.70806	-98.98250
CALLAHAN	23	212	235	12905	2334.25	5.53	0.18084	0.92335	69.85	32.39611	-99.39722
CASTRO	21	112	133	8285	2329.23	3.56	0.75501	0.98556	44.45	34.54917	-102.31528
CLAY	14	163	177	11006	2890.87	3.81	0.16377	0.92618	82.55	33.81611	-98.19389
COOKE	14	208	222	36363	2327.91	15.62	0.23742	0.79166	95.25	33.63028	-97.14028
DALLAS	111	652	763	2218899	2353.16	942.94	0.07489	0.15136	95.25	32.78278	-96.80389
DIMMIT	18	277	295	10248	3456.29	2.97	0.03408	0.82899	57.15	28.52667	-99.86250
EL PASO	26	255	281	679622	2628.01	258.61	0.08331	0.25956	25.4	31.79028	-106.42333
FAYETTE	50	427	477	21804	2485.97	8.77	0.19936	0.92090	95.25	29.90833	-96.87500
GAINES	4	102	106	14467	3892.34	3.72	0.66713	0.98535	44.45	32.71861	-102.65000
GUADALUPE	18	254	272	89023	1849.69	48.13	0.27558	0.84236	82.55	29.57444	-97.96528
HALL	10	186	196	3782	2341.56	1.62	0.37852	0.92268	57.15	34.72667	-100.54167
HARRIS	159	873	1032	3400578	4604.20	738.58	0.08037	0.22768	107.95	29.76278	-95.38306
HARRISON	22	298	320	62110	2370.07	26.21	0.08926	0.34299	107.95	32.54278	-94.36361
HEMPHILL	47	471	518	3351	2362.22	1.42	0.12953	0.94009	57.15	35.91083	-100.38389
HENDERSON	26	425	451	73277	2457.90	29.81	0.14241	0.52432	95.25	32.20278	-95.84917
HILL	11	140	151	32321	2552.82	12.66	0.40252	0.83211	82.55	32.00944	-97.12444
HOCKLEY	11	113	124	22716	2353.13	9.65	0.70747	0.83286	44.45	33.58472	-102.37222
HOUSTON	31	393	424	23185	3203.37	7.24	0.13795	0.55644	107.95	31.31694	-95.45833
JACKSON	34	274	308	14391	2219.70	6.48	0.36240	0.89805	95.25	28.97667	-96.64667

Appendix – Continued

County Name	Non-native Species	Native Species	Total Species	Population (2000)	Area (km^2)	Population Density (persons/km^2)	Cropland (% of area)	Farmland (% of area)	Precipitation (cm)	Latitude	Longitude
HOUSTON	31	393	424	23185	3203.37	7.24	0.13795	0.55644	107.95	31.31694	-95.45833
JACKSON	34	274	308	14391	2219.70	6.48	0.36240	0.89805	95.25	28.97667	-96.64667
JEFFERSON	87	600	687	252051	2878.15	87.57	0.21600	0.46858	139.7	30.08000	-94.12667
JIM HOGG	17	276	293	5281	2942.64	1.79	0.01350	0.88053	57.15	27.31139	-98.68111
KENEDY	29	463	492	414	5039.08	0.08	0.00225	0.73005	69.85	27.22167	-97.78917
KENT	1	69	70	859	2338.53	0.37	0.09274	0.98225	57.15	33.24932	-100.57477
KERR	44	465	509	43653	2868.83	15.22	0.05676	0.86550	69.85	30.04639	-99.14056
KINNEY	18	326	344	3379	3536.14	0.96	0.01331	0.68806	57.15	29.31535	-100.41512
LAMAR	7	72	79	48499	2415.09	20.08	0.36630	0.87302	107.95	33.66250	-95.54778
MASON	14	247	261	3738	2414.34	1.55	0.09571	0.89911	69.85	30.74780	-99.23188
MCLENNAN	31	280	311	213517	2745.99	77.76	0.35606	0.78052	82.55	31.55152	-97.15593
MEDINA	21	336	357	39304	3456.42	11.37	0.20319	0.87595	69.85	29.34684	-99.14554
MILLS	13	166	179	5151	1942.21	2.65	0.15552	0.98812	69.85	31.45048	-98.57110
MITCHELL	3	93	96	9698	2372.17	4.09	0.27937	0.98093	57.15	32.39616	-100.86214
NACOGDOCHES	63	505	568	59203	2541.64	23.29	0.09450	0.42215	107.95	31.60886	-94.65086
OLDHAM	25	284	309	2185	3888.66	0.56	0.10959	0.91631	44.45	35.24555	-102.42511
PARKER	19	392	411	88495	2357.12	37.54	0.17814	0.75812	82.55	32.75917	-97.78500
REAGAN	8	130	138	3326	3045.77	1.09	0.07699	0.90857	44.45	31.19391	-101.45883
REEVES	25	294	319	13137	6842.62	1.92	0.08085	0.61528	25.4	31.41542	-103.49996
ROBERTSON	118	949	1067	16000	2242.08	7.14	0.21197	0.82181	95.25	31.02622	-96.48609
SABINE	23	321	344	10469	1493.41	7.01	0.02117	0.08597	139.7	31.34261	-93.85491
SCHLEICHER	17	170	187	2935	3394.57	0.86	0.05951	0.95444	57.15	30.86075	-100.59833
SHERMAN	25	155	180	3186	2391.08	1.33	0.66462	0.98874	44.45	36.33616	-102.07145
TARRANT	69	624	693	1446219	2324.47	622.17	0.08032	0.26877	82.55	32.75736	-97.33318
THROCKMORTON	7	75	82	1850	2371.06	0.78	0.16132	0.97936	69.85	33.18140	-99.17817
TOM GREEN	21	220	241	104010	3990.00	26.07	0.85673	0.93667	57.15	31.45311	-100.45250

Appendix – Continued

County Name	Non-native Species	Native Species	Total Species	Population (2000)	Area (km^2)	Population Density (persons/km^2)	Cropland (% of area)	Farmland (% of area)	Precipitation (cm)	Latitude	Longitude
TRAVIS	231	1093	1324	812280	2647.18	306.85	0.11612	0.40127	82.55	30.26722	-97.76389
TYLER	31	602	633	20871	2423.48	8.61	0.03285	0.14069	139.7	30.77625	-94.42124
WILBARGER	4	99	103	14676	2533.27	5.79	0.37912	0.98065	69.85	34.15112	-99.29047
WOOD	33	488	521	36752	1802.11	20.39	0.16106	0.52502	107.95	32.79603	-95.44450

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