

The Movement of Mexican Migration and its Impact based on a GIS
Geospatial Database.

by

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To My Father, Professor Carlos Rodriguez

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List of Abbreviations

GIS	Geographic information system
GISci	Geographic information science
HMMGD	Historical Mexican Migration Geospatial Database
MMP	Mexican Migration Project
MPI	Migration Policy institute
MXCD	Mexico City/Ciudad de Mexico
SQL	Structured Query Language

Abstract

Throughout history, the United States has experienced waves of immigration from various nations, and the 170-year history of Mexican nationals migrating to the U.S. is well documented. Migration has had a major impact on the United States as immigrants and their decedents have contributed since the founding of the country, thus making the topic contentious. Further, understanding and measuring migration is complicated as it is not housed within one academic field. To help academics from various fields explore their questions about migration, this project developed a database allowing data exploration from the methods and tools of Geographic Information Science (GISci). Using GISci, this project created a geospatial database that can be and how they relate to sociodemographic data and other trends. The database could then reuse the data and update as the data becomes available. This was done through creating a non-relationship database diagram model. Relevant data was gathered from migration institutes and other sources into Excel spreadsheets before imported into ArcMap. Once the data was transferred into their appropriate attributes base on the diagram, thematic maps, and Structured Query Language (SQL) statements were tested to ensure that these features in ArcMap could be additions to the database. The GIS software ArcMap visualized the data spatially based on the research questions of the user. The database was tested and reviewed by five individuals who specialize in Mexican migration. Their feedback indicated that the database is worthy as an exploratory and collaborative tool and is appropriate in the fields of Anthropology, History, Geography, Mexican-American studies, and other academic fields.

Chapter 1 Introduction

Human migration is more than the movement of people from one location to another, but a phenomenon that has shaped human history. The United States of America has experienced and owns its existence to the effects of migration before it was its own nation-state. Since the 17th century numerous cultures have since been a part of this influx of migration. Despite these various cultures, the US has had controversial policies in immigration targeting and singling out certain cultures throughout the US history. Since the 19th Mexican immigrants have experienced this isolation even to this day in the 21st century, as much of the attention of immigration continues to be focused on people from Mexico.

Often the negatives overshadow the contributions of these immigrants, do certain politicians and policymakers really appreciate what industries and local economies in the United States are impacted by migration? This is where a spatial geodatabase comes in, allowing users to extract the spatial and non-spatial data of the rich history to better understand the impact of migration. This database will have the opportunity to allow users to view the impact of migration from a timeframe from 1850 to 2015. A benefit from this database will ensure that by studying the spatial phenomenon of the patterns and flows of migration this will allow a complete overview of the movement of people that can compare its influence from one location to another throughout time.

Due to the media coverage and long history of Mexican migration to the U.S., it is one of the most well-documented and heated migrations in the U.S. that can be chosen for this spatial database. Many Scholars from different academic fields such as anthropology, history, economics, global studies, geography and Chicano studies have researched the impact of this migration in both countries throughout history and up to the present day. These scholars have

seen that with migration comes the exchange of cultures, experiences, and opportunities. A result of this migration can further be seen in the Mexican-American population as in the year 2015, the American Community Survey reported 35 million out of 323 million total Americans were identified as Mexican descendants (American FactFinder. 2015).

The objective of this thesis is to develop a database known as the Historical Mexican Migration geospatial database (HMMGD) that can be used to explore the push and pull factors or significant historical forces that drove the migration back and forth between the two countries. The byproduct of associating these historical forces will allow users to see the effects in both countries from Mexican immigration such as the number of immigrants, and industries. This database will compile data on migrant flows from Mexico to the U.S. at a state level, including related industry, census, and eventful data that pulled Mexican migrants to various locations within the U.S. The data for this project will be imported into two centralized tables that will allow its intended users to find how migrant flows relate to historical driving factors, review datasets, perform SQL queries and create thematic maps as additional features inside the database.

The remainder of this chapter discusses the history of Mexican migration, as well as an explanation as to the importance of the project within the multiple academic fields of Mexican migration. There is also a description of the intended users and the database application's organization and performance.

1.1. Mexican Migration Background

Mexican migration into the United States as stated before is a long and well documented history that has influenced many aspects of social and cultural life in both the U.S. and Mexico. This thesis will highlight some of the major elements and events of Mexican migration. To

understand the being of Mexican migration into the U.S., one must trace back its roots to both Native American migration and Spanish colonialization. Archaeological data, has discovered that this migration can be traced backed to about 20,000 ago when Native Americans traveled throughout the Americas (Solis 1999). One ancient native migration can be seen in a trade network between the American Southwest and Mexico where numerous artifacts that were transported and traded between the two areas especially during the 1200's to 1400's. Traders from Mexico would exchange goods and ideas with merchants of the American southwest which created an economical trade network set in place hundreds of years before the arrival of Columbus (Cordell and McBrinn 2012). With the Spanish/Catholic missionization and colonization of the modern American Southwest in the 1600's to 1800's, Spanish, Mexican mestizos (half Indigenous and half European), and Mexican natives traveled north and interacted with the natives of the southwest in the current U.S. (Spicer 1992). Thus, Mexican immigrants have been following a migration path based on their indigenous ancestry for thousands of years.

After the Mexican war of independence Mexico acquired the modern American southwest by 1820. By the time Mexicans had interactions with Anglo-Americans in the 1830's, traveling routes and towns were already created by both indigenous, mestizos and Spanish settlers (Meyer, Sherman, and Deeds 2011). The landscape of the Northern Mexican territories was drastically changed by Anglo-American immigrants traveling to the Mexican territory of Texas in the 1830's, which resulted in the Texas Revolution of 1835. The Texas Revolution became a precursor to the Mexican-American War of 1848 and the Gadsden Purchase of 1854. These events would allow the U.S. to acquired much of the modern day Western United States. This ushered in a new era of how Mexican migration was viewed in the United States as the

former Mexican territories was now part of the United States (Meyer, Sherman, and Deeds 2011).



Figure 1. History map of how the United States acquired its modern day territories Source (edited): The National Atlas of the United States of America, U.S. Geological Survey, US Department of the Interior. <http://www.maps-world.net/usa/historical-map.htm>

From the onset of the 19th century to the 21st century, Mexican migration can be split into three periods: open migration 1850-1923, contingent migration 1924-1964, and restrictive migration 1965-present. The open migration period was a time when thousands of European immigrants were finding opportunities in the United States, while at the same time Mexican immigrants were continued to settle in the Western U.S. As a result, during much of this time period Mexican immigrants and Mexican-Americans could be found working in the cattle, ranching, mining, logging, and railroad industries the Western U.S. Numerous industries in the

Western U.S. found themselves hiring a vast number of Mexican employees due to the abundance of workers resulting from the open border policy (Sheridan 2012).

The contingent immigration period (1924-1964) first started to see restrictive actions when in 1924 the United States Border Patrol was founded, and the United States began more to impose restrictive measures on immigration while also establishing immigration programs with Mexico. This included the Bracero program of the 1940's, which facilitated the labor of Mexican citizens in the U.S. without conferring citizenship. One harsh event in this period was the Mexican repatriation, when in the 1930's an estimated 2 million Mexican immigrants and U.S. born Mexican-Americans with U.S. citizenship were forcibly sent to Mexico (Acuña 2007).

In 1942, an agreement between both nations established the Bracero program to help with the war effort of World War II. Mexican immigrants found themselves once again working in the railroad, agriculture, and others key western industries. The program lasted until 1964, resulting in over 2 million Mexican migrants in the U.S. (Acuña 2007).

At the end of the Bracero programs, stricter laws created a militarized U.S.-Mexico border. This period (1965-present) is termed the restrictive migration period. In addition to federal immigration regulations, some U.S. states have created laws to combat against incoming undocumented workers. Strict laws and increased border security, such as physical barriers and patrols, have forced incoming immigrants to travel through harsh terrain in the Sonoran and Chihuahua desert. Tragically, this has resulted in the death of thousands of immigrants deceased (United Nations News 2018). The debate continues as Democrats and Republicans consider changes to immigration laws and have sharply different perspectives on citizenship

1.2. Motivation

The motivation for this project was twofold. One was to explore Mexican immigration history and prove the group being influential and under recognized in the United States. The second element was to measure the impact of the migration group. Fortunately, a spatial database provided the pathway to achieve these two elements. From the numerous cultures that have migrated to the US, European cultures such as the English, German, Irish, and Italian have been praised as a major influence in the U.S. An example came be since from the pilgrims who have been credited as the founders of the United States.

A geographical trend started to be noticed, the migrations mentioned above impacted the Eastern United States initially and then these European cultures migrated from the East to the Western United States, which overshadowed what cultures were already established in the west. It became clear to choose Mexican migration since it been in the American West for over 500 hundred years and not to mention its impactful indigenous ancestry. Due to its less popular known migration influence Mexican migration would allow a renewed chance to see its impact on the U.S. (Pew Center Research 2013).

After finding the first element for this project, the second element became clear with the tools and techniques of GIS. When it came to find a reliable method to track the movement of human impact data, the sciences of GIS created a reliable solution to track and record this spatial data. Data collecting, and analysis methods produced maps and spatial databases thanks to the software of ArcMap. From these two elements a project to measure and study the patterns and pulls of Mexican migration coming to the United States of America, was a clear choice to perform a thesis project. As a result, the database has the potentially to be a collaborative

database that scholars can acquired Mexican migration data at one central database instead of searching for multiple literature and census reports.

1.3. Database Design Overview and Users

The following section is an overview of the concept and functionality of the proposed database, along with a short description of the different types of users who can utilize this outcome of the project, Chapter 3 will later describe a greater boarder break down of the design and development. This project is built in ESRI ArcGIS Desktop version 10.6 as a spatial database and relies on two data tables that represent the US and Mexico that contain a large assortment of data available on Mexican migration from 1850 to 2015. This historical data was extracted and organized from literature and ranges from local and national census scales throughout different time periods. Below is an example of some of the information about Mexican migration throughout the decades that will be included in the database. More about the metadata will be discuss in the methods section of chapter 3.

Table 1. Projects Table and Data Column Overview

feature class	Historical Events	Notable Work/industry	Mexicans as highest immigrant	Mexican Immigrant population	Mexican American population
US States	✓	✓	✓	✓	✓
feature class	Historical Events	Number of Immigrants from Mexican state			
Mexico States	✓	✓			

The scale of this database includes the 50 States of the USA, 31 Mexican States and both countries federal districts as state boundaries polygons in feature classes. The timescale for this database ranges from 1850 to 2015. Given this large timescale and data availability, not all datasets are available for every year.

The intended users for this project includes cultural anthropologists, historians and geographers. Once the users view the database and see what information is included in this database users can then use Structured Query Language (SQL) to extract and explore questions of their own. Ultimately, users will be able to physically see maps of the migration flows and patterns over time. This spatial database can allow users to compare both push and pull factors and to explore the relationship between any historical events and Mexican migration at a certain time.

After the user queries and finds their desired information, other variables can be found such as the states with the highest number of Mexican immigrants or what state industries hired Mexican immigrants can be explored. Several SQL queries would be used to demonstrate the database functionality in research inquires. More information about SQL queries and the methods to create databases is discussed further in Chapter 3. The next following pages will include chapter 2 discussing the various types of related work in the area.

Chapter 2 Related Work

Migration from Mexico to the United States has been influenced by historical, environmental or push and pull events. Therefore, resources from different academic fields about Mexican migration should be reviewed. In the field of Geographic Information Science (GISci), a variety of research that has been focused on migration however there is still plenty of room for more research in Mexican migration. This chapter provides a review of the related literature. Section 2.1 will discuss important data that has not been digitalized. Section 2.3 reviews the GISci research related to migration. Section 2.3 discusses a related database about Mexican migration. Section 2.4 discusses related interactive maps that, while useful, could be supplemented as one of the futures for the Historical Mexican Migration Spatial Database (HMMSD).

2.1. Literature Background

The academic fields of anthropology, global studies, ethnic studies, economics, and spatial sciences have all looked extensively at immigration. Scholars from many disciplines have researched the movement of humans from one location to another. A large portion of data for this database came from various literatures from scholars who have focused on Mexican migration. Given that the background literature is inherently multidisciplinary, cohering the different sources can be challenging to collect.

An inclusive database could benefit all these above-mentioned academic fields. that would enable them to answer their research questions about Mexican/US migration. Many of these academic fields do not seek quantitative approaches to their research questions.

With an accessible database, they may be able to combine their qualitative theoretical background with the tools of the spatial sciences in a way that would further research in this academic space.

Some of the literature includes the documented historical migration of Mexican immigrants in the industries of the railroad, mining, and agriculture. These industries illustrate where in the United States these Mexican immigrants were heading to and settling.

Other important literature to mention was the historical pull and push factors of Mexican migration. Since this data was not digitalized it took time to see what information could be incorporated into this database. The literature will be further discussed in this Chapter. After discussing where this related data and research is primarily found, it became important to realize the potential of creating a database that contain literature data so that scholars could use a centralize database that contains related migration data that may assist them in their research question otherwise this undigitized information would remain in scattered throughout the library allies.

2.2. Related Mexican Migration Database

After researching the historical literature, it appeared that there were a limited number of academic articles about migration using GIS from online observations. In addition, hardly no Mexican Migration database have been developed. Since this migration is well documented, one would imagine there would be some form of a database or any advanced technology to aid in the quantitative analysis of Mexican migration to the U.S. There are several Mexican migration-related articles listed below that use GIS for analysis, but none that have created a database open that would enable others to manipulate the relevant data.

The Mexican Migration Project (MMP) is a joint endeavor by the Office of Population Research at Princeton University and the department of Estudios Sobre Movimientos Sociales (DESMOS) at the Universidad de Guadalajara. The project was originally created in 1982 and has conducted surveys of the demographics of Mexican immigrants since. The data includes

information about the place of origin, current location, family information, health, and other related ethnology from conducted surveys from interviewed immigrants. While the project allows the public to view the data, the information is organized into two websites and can be a confusing without referring to each of the two websites. The bulk of the information behind the MMP is located on its website, this website explains how the data was organized yet the data is located at the Princeton's Office of Population Research's (OPR) website which does not have any descriptions of the data on the website itself. The MMP solution to this matter is to cross reference the OPR's website with a downloadable codebook back from the MMP main website. (Mexican Migration Project 1982).

Seeing these aspects of the MMP database, the MMP database has limited capabilities when compared to a spatial database created in ArcMap. Due to the MMP's layout it is a static database meaning the data is only stored and organized in one location and its final product is statically text in the form of CSV, SAS, SPSS, and STATA file types. Unlike a spatial database the information is more dynamic and interactive, data can be added, stored, organized and be reflected on a location in the world visually by creating GIS data types such as polygons, lines and points. In comparison with the HMMGD, the MMP db is a data mine there is several datasets that have been well organized but only reflects Mexican migration by text.

The HMMGD on the other hand has stored and organized data from sources related to Mexican migration but reflects this information on a map thus making it spatial data. Added features to the HMMGD can utilize the tools from ArcGIS, for this thesis the SQL and Symbology features were used to see additional byproducts of the HMMGD. Thus Ideally, a spatial database in ArcMap such as the HMMGD would provide interactivity with a visual interface and a variety of tools that can create maps and SQL queries.

The MMP database does provide many benefits as a major data source on Mexican migration from its collected data acquired from surveys that can even influence a spatial database to use the information. One type of dataset in the MMP that can be converted into spatial data for the HMMGD, is birth location and current location of the interviewed immigrant. By combining this dataset from the MMP the HMMGD can show a spatial map of the path of the interviewed immigrant from Mexico to the United States. Ultimately, other spatial data was also lacking in the MMP database that were deemed essentially for the HMMGD project. The spatial database developed in this project will contain and share this type of spatial information from a greater time period from 1850 to 2015 that goes beyond just the individual immigrant.

2.3. Related Geography/GIS research

In Do Rainfall Deficits Predict U.S.-bound Migration from Rural Mexico? Evidence from Mexican Census (Nawrotzki, Riosmena, Hunter 2013), the authors reveal how monitoring rainfall patterns in rural Mexican communities can influence or drive immigrants to the United States. The project used data from the 2000 Mexican Census and the Mexican National Institute for Statistics and Geography that was related to rural locales, socioeconomic and state level precipitation. Models were also conducted to see how the rainfall impacts household-level out migration and monitoring sociodemographic and economic factors. The project founded that there was significant association with rainfall patterns that affected Mexican Migration but in certain states the driest states seemed to be the most impacted.

To relate or find a common aspect in the HMMGD, this article used the rainfall as a push factor that drove Mexican migration shifts. The data compared annual mean precipitation from 1988 to 1999 and crossed referenced the results with Mexican census to see any spatial patterns.

While this project has some similarities with the HMMGD, the project by Nawrotzki, Riosmena, and Hunter only focuses on Mexican States and only on rainfall. The HMMGD provides both the US and Mexico states and contains multiple historical and spatial data. This in return allows the user to see the impact of multiple historical events or push migration in the US and Mexico that can see what outcomes we can make of it.

Another related article, *The U.S.-Mexican borderlands region: a binational Spatial Analysis* (Pick, Viswanathan, Hettrick, 2001), did not focus so migration but use the GIS methods to analysis social, demographic and economic characteristics along the US-Mexico border. The area of study included the 246 counties in 4 US states and 274 municipalities in 6 Mexican States along the 1954-mile-long boarder. One of the main goals of this paper was to examine any mayor socioeconomic differences the western and the eastern border side, including differences between rural and urban centers. The methods included the use of a database, models, spatial analysis software and tools. Attributes for the database were used from US and Mexico 1990 Census and incorporated into a relationship database in Microsoft access. The results were mapped from ESRI ArcView/ArcInfo. The project overall found differences in between different regions of the study area particularly in poverty levels and improved housing characteristics that would allow policy and planning makers create discussions about the results. (Pick, Viswanathan, Hettrick, 2001),

While this project looks at socioeconomic characterizes along the US-Mexico border it's not too part far part from the HMMGD. Both have a few similarities, but also differences that lie when these two projects were created. The similarities can be seen in a similar area of study, they use spatial analysis software and methods, as well as a database, however The HMMGD was created almost 20 years after the *The U.S.-Mexican borderlands region: a binational Spatial*

Analysis. There would be ultimately be a technology gap of what GIS software was available in 2001 vs 2018 as several upgraded versions of ArcView/ArcInfo as well as Microsoft Access have been released since 2001. The HMMGD also uses a database that reflects its data spatial on feature classes.

Other notable related works include interactive maps from the Migration Policy Institute, Pew Research Center, and the New York Times (Aisch. and Gebeloff, 2014, Bloch, and Gebeloff, 2009). Each article discusses Mexican migration and/or American migration with the goal of showing how migration has changed throughout time. Each article includes an interactive map supported by java script, adobe flash and/or openstreetmap.org. These maps are accessible to the public and show spatial data and an adjustable timeline where the viewer could see migration patterns base on a certain period. These are useful with respect to giving information as to a specific area of migration, however all lack major components of the HMMGD. These components include easy access to data share, create customized maps from symbology and SQL maps, and include addition relatable data.

The following paragraphs will review three different maps that discuss their differences from the HMMGD. The Migration Policy Institute has exemplary interactive maps, created in openstreetmap.org. These interactive maps allow users to click, zoom in and find data reflecting the area of study. One of these maps contains the 31 Mexican States and Mexico City formerly Distrito Federal to show the number of Mexican immigrants from each Mexican state going to the United States from the years 2004 to 2015. The other map includes the 50 United States and District of Columbia to show specific Immigrant culture population by State and County between 2012 and 2016. The Pew Hispanic Research Center has developed an interactive

timeline map showing the foreign-born. populations by country of origin from 1850 to 2010 and 2013 (Pew Research Center 2015).

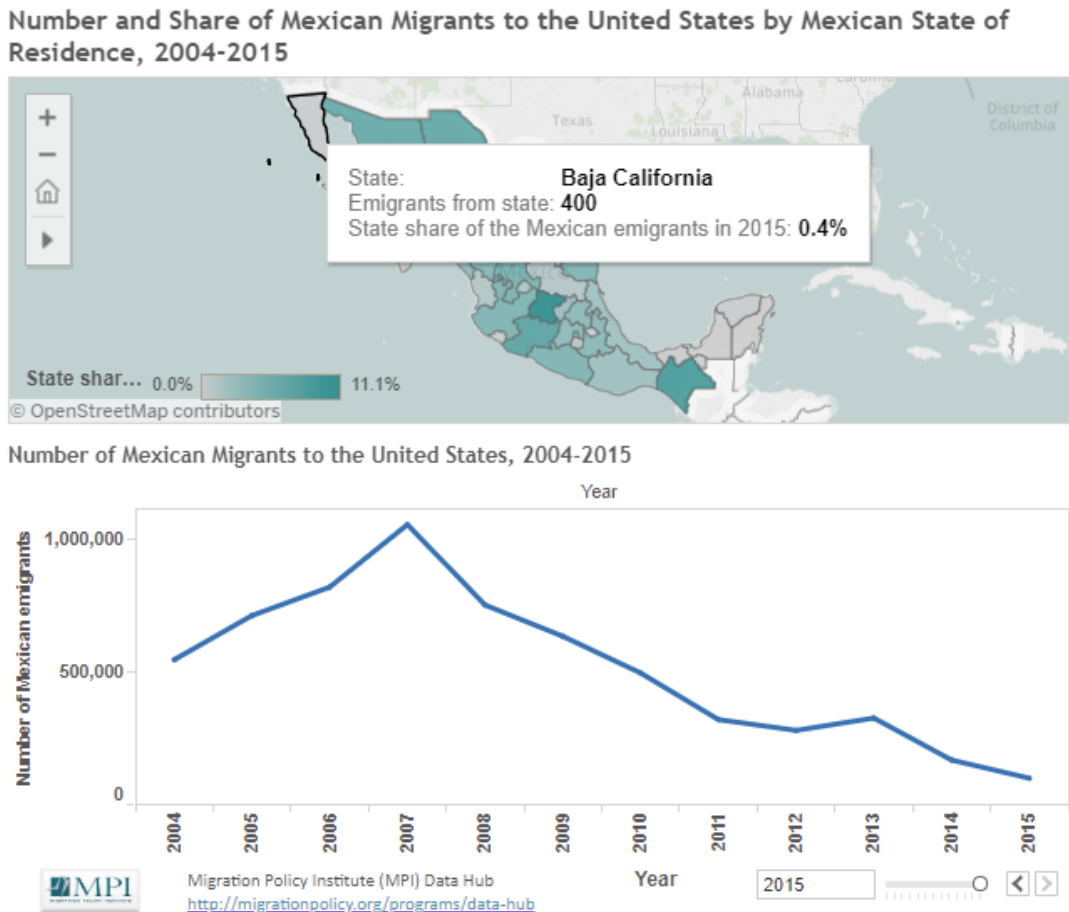


Figure 2. An interactive Map from the Migration Policy Institute, showing the number of Mexican Immigrants to the US by each Mexican state from 2004-2015. Source: Migration Policy Institute

A theme in the Pew Hispanic Research center map showed how immigrants cultures have changed throughout time, in the 50 United States. The largest influxes were from Ireland, German, Italy and Mexico. Lastly, The New York Times created two interactive maps showing the origin of each state’s population at the county and states levels, organizing the data by race and those born outside the state (Aisch,. and Gebeloff,

2014, Bloch. and Gebeloff, 2009). These interactive maps, however valuable, lack accessible datasets, related subtopics, and historical data. In total, all these sources prove useful, but none constitute a user-queried database

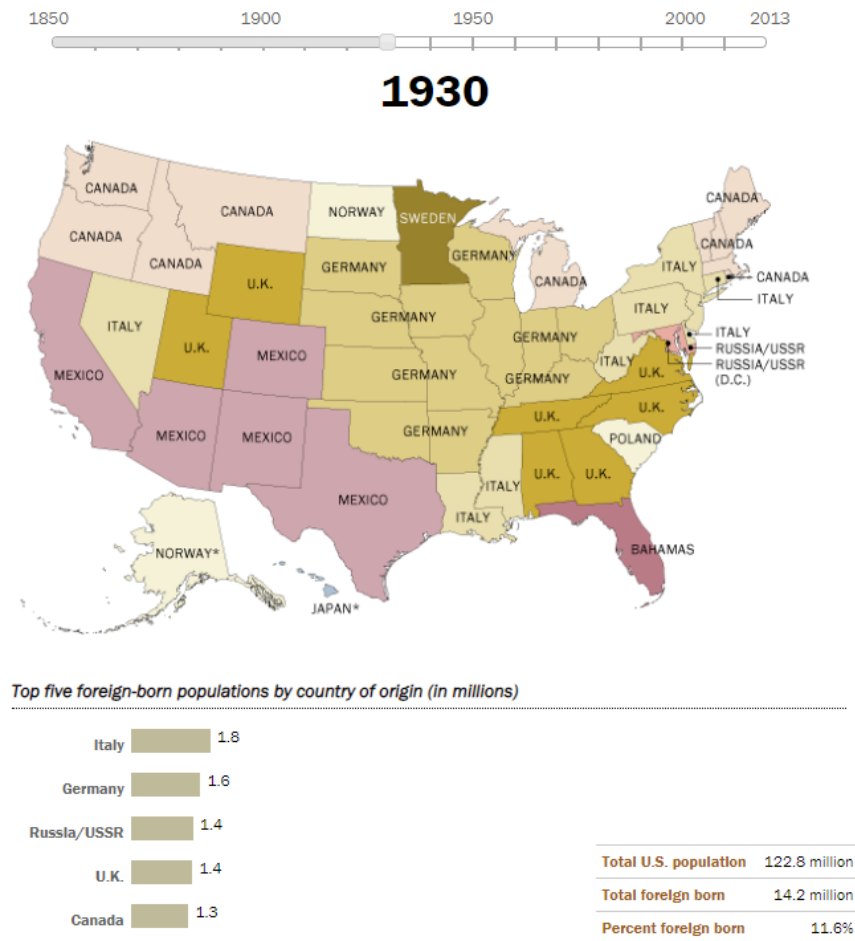


Figure 3. Timeline Map showing the Highest Immigrant culture by Country Source Pew Research center

Another noticeable component missing from related work is the use of SQL queries. Unlike the maps above, the HMMGD will allow users to perform SQL queries in ArcMap's built-in SQL Query based on the data that was acquired from the various sources. that can be performed. Users can ask and answer their own questions using the data included in the database.

Further, users can create symbology and choropleth maps based on selected data by sharing map packages from ArcMap.

While some of the reviewed literature use GIS to explore Mexican migration, they fall short of what this thesis proposes. The preceding articles that contained interactive maps showed limited themes that have impacted Mexican migration. These maps included research on migration and in some respects, GIS could be seen in these maps in terms of spatial data and cartography, but lack user-driven interactivity. The spatial database proposed in this thesis is allows users to use an interactive program to explore spatial questions using 170 years of data.

Chapter 3 Data and Methods

This chapter outlines the methodology for the construction of the Historical Mexican Migration Geospatial Database. A series of four sections cover how each individual stage played a role in the development of this database. Section 3.1 describes how the database was designed, constructed and what requirements were taken into consideration. Section 3.2 is an overview of the source data that include how the datasets were acquired and why they were important for this project. Section 3.3 looks at the process of the source data import and display in ESRI ArcGIS Desktop. Section 3.4 uses the examples of SQL to showcase how the queries were used to enhance the users' experience.

3.1. Research Design

The first tasks of creating this geodatabase was to establish a non-relationship diagram. Initially an ER or Entity relationship was created, and scenarios were performed to see how the database would be reflected using an ER diagram. Due to the datasets focusing on a large time scale historical literature data that typically does not go into spatial databases, it concluded that if one were to create an ER diagram for this project there would have to be over 20 data tables that need to be connected property.

Seeing how there is an abundance of historical literature data that have been not formed into spatial data the chore of converting this literature data was already a major step forward in creating a historical database on migration. It was decided that to convert historical data as spatial data was to simply organize and relate the historical data to the area or state that received or was impacted by Mexican migration. An example of this could be to mark the US states that have been documented to have large numbers of Mexican immigrants working in agriculture

throughout the years. This method ultimately established two large database tables for such a project. Figure 3 below shows the two tables included in the data model.

Mexican Migrants to the US		
PK	OBJECTID	number
	State	text
	1990_event	text
	1993-1994	number
	1995-1996	number
	1996-1997	number
	1997-1998	number
	1998-1999	number
	1999-2000	number
	2000_event	text
	2000-2001	number
	2001-2002	number
	2002-2003	number
	2003-2004	number
	2004	number
	2005	number
	2006	number
	2007	number
	2008	number
	2009	number
	2010_event	text
	2010	number
	2011	number
	2012	number
	2013	number
	2014	number
	2015	number

Mexican Migration in the US		
PK	OBJECTID	number
	States	text
	1850_event	text
	1850_HI	number
	1860_event	text
	1860_HI	number
	1870_event	text
	1870_HI	number
	1870_work	text
	1880_event	text
	1880_HI	number
	1880_work	text
	1890_event	text
	1890_work	text
	1900_event	text
	1900_HI	number
	1900_work	text
	1910_event	text
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	1960_work	text
	1970_event	text
	1970_HI	number
	1970_work	text
	1980_event	text
	1980_HI	number
	1980_work	text
	1980_MAP	number
PK	1990_event	text
	1990_HI	number
	1990_work	text
	1990_MAP	number
	2000_event	text
	2000_HI	number
	2000_work	text
	2000_MAP	number
	2010_event	text
	2010_HI	number
	2010_work	text
	2010_MAP	number
	MI20102014	number
	C20102014	number
	U20102014	number
	2015_MAP	number

Figure 4. Diagram of the HMMGD

A spatial database allows the user to store, handle, and manage data for spatial and non-spatial data. Using a comprehensive GIS software program that has the features of creating a database, and inputting/editing the data tables with relationship and can visualize the data query results were essential. ESRI ArcGIS Desktop became the best solution that contained all these capabilities.

Feature classes proved to be a very useful way to show the ideal data location and storage inside ArcMap. Since this database is based on the United States of America and Mexico, polygon data of both countries were included in the project. It was then chosen to view the impact of Mexican Migration not at a national level, but at a state level, this would then ensure that users could pin point the impacts at a smaller or general state area. The two feature classes include polygon state boundaries data of the 50 United States, 31 Mexican States and each federal district from the 2 countries and were imported from ArcGIS online. These two feature classes then became the two main tables and layers of this database. Initially these features classes were selected from ArcGIS online as shapefiles but were converted into feature classes which is suitable for a geodatabase and future additions. The United States shapefile was deemed as a quality set for this project as the file contained the polygon boundaries of all 50 States and the District of Colombia was compiled by username esri_dm an ESRI account. The file already had plenty of usually information from ESRI, TomTom, the U.S. Census, and the US Department of Commerce, however other attributes were deemed unrelated for the HMMGD. Attributes such as state names, state size, polygon size, state population for the year 2010 remain the attribute table while demographic numbers of race, agricultural and household data were eliminated.

The Mexico shapefile was acquired by Kyle Walker of the Texas Christian University under the username kwalkeruc and appeared to have the best quality shapefile that contain all Mexican State and Mexico City boundary polygons. Walker was able to include attribute data base on both statistical and spatial data from the INEGI (Instituto Nacional de Estadística y Geografía), and Natural Earth.

Each polygon on the migration rate to the US from 2004-2009 per 1000 population, the percent of the workforces, and tertiary sectors in 2010 and the 2008 gross domestic product per capita. This data was eliminated from this project since at it was planned that the Mexican feature class would just need historical event and immigrant numbers, perhaps this information from Walker could later be incorporated and related to the research of the HMMGD.

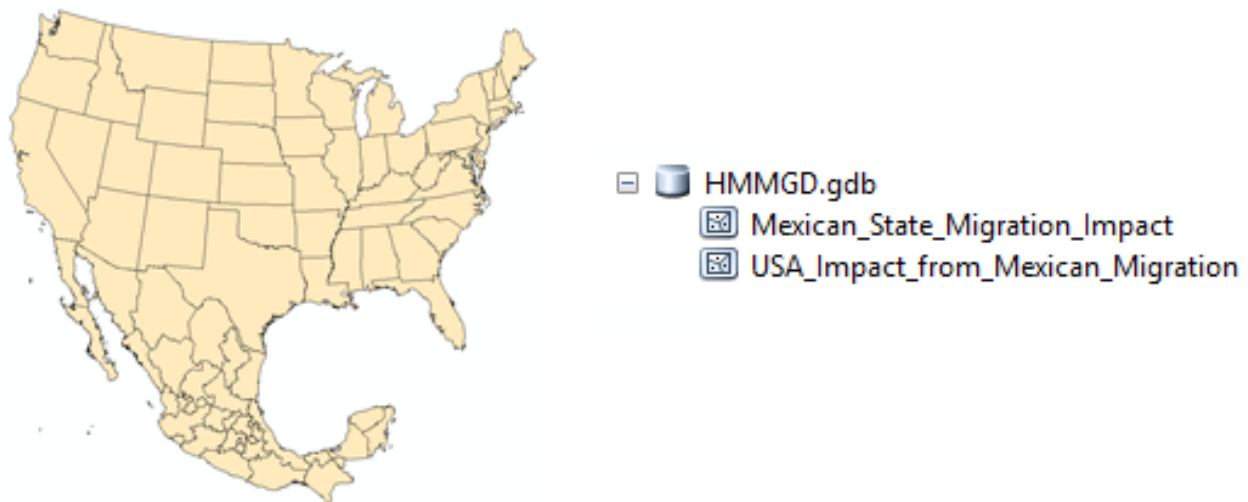


Figure 5. A look at both two feature classes in ArcMap and the ArcCatalog

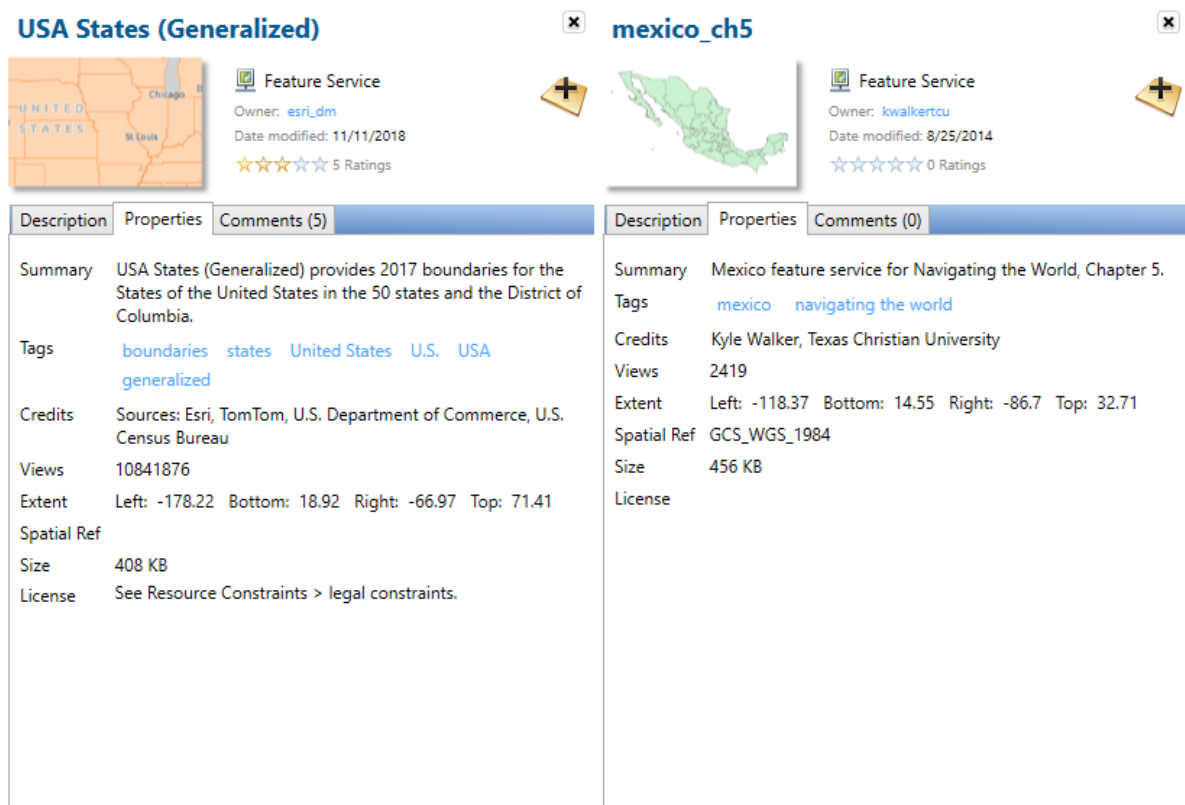


Figure 6. The properties of both shapefiles before they were converted into feature classes.

After establishing which feature classes to represent the tables, it came time to decide which attribute data would be included in the tables. Listed below are the organized attribute columns that included both the US and Mexico data that was used in the HMMGD. The tables included datatypes from text and numeric data. The United States table proved to be a little more time consuming; as data recording from each decade of 1850 to 2015 was included in three data sets. The following attributes will be further explained below: “decade” is a placeholder to represent the multiple decades that were added to the US table. In total the United States table included the following data attribute types “decade”_event, “decade”_HI, “decade”_work, 1980_MAP, 1990_MAP, 2000_MAP, 2010_MAP, MI20102014,C20102014,U20102014, and 2015_MAP.

Table 2. Projects US Data table and Attribute definitions

Name of Table Attribute	Examples	Data Example	Meaning
("decade" _event) 15 columns	1850_event 1940_event 2000_event	Mexican American War 1848, Gadsden Purchase 1954 Bracero Program 1942 Financial crisis 2007-08	events that are a driving factor that push migration into a certain state during the according decade
"decade_HI" 15 columns	1900_HI 1980_HI 2000_HI	1,0	States that received Mexican immigrants as their highest immigrant. 1 represents Mexican when were the highest immigrant. 0 represent when Mexicans were not the highest
"decade_work" 14 columns	1890_work 1930_work 1980_work	Railroad, Agriculture, Mining	Well known Industries that hired Mexican labor
"decade" _MAPOP 5 columns	1980_MAPOP 1990_MAPOP 2010_MAPOP	Numerical data Double data type	The number of Mexican-Americans for each US state
MI20102014		Numerical data Double data type	The number of Mexican immigrants for each US state
C20102014		Numerical data Double data type	The number of Mexican immigrants who are Naturalized US citizens for each US state
U20102014		Numerical data Double data type	The number of unauthorized Mexican immigrants for each US state

Table 3. Projects Mexico Data table and Attribute definitions

Mexico shapefile table

Name of Table Attribute	Examples	Data Example	Meaning
("decade" _event) 3 columns	1990_event 2000_event 2010_event	NAFTA 1994 Drug War 2006 Mexican Economy Rise	events that are a driving factor that push migration into a certain state during the according decade
1990's-2004 Mexican State migrates to the US	1993-1994 1996-1997 2002-2003	Numerical data Double data type	Number of Mexican migrants to the US from each Mexican State in a two-year time
2004-2015 Mexican State migrates to the US	2004.2005, 2006, 2013.2014,2015	Numerical data Double data type	Number of Mexican migrants to the US from each Mexican State by year

To summarize what each data column represents “decade”_event, indicates any historical event that occurred during that decade, “decade”_HI (highest immigrant) represents the US state that had Mexican immigrants as the highest immigrant culture that that decade. Categorized as the number 1 for Mexican and 0 for other in the data column. “Decade”_work indicates any significant well recorded industry that used Mexican immigrants such as agriculture and railroad work. 1980_MAP, 1990_MAP, 2000_MAP, 2010_MAP, 2015_MAP all represent the Mexican-American population “MAP” according to the year. MI20102014, C20102014, U20102014 represents Mexican immigrants “MI”, Mexican immigrants who are Citizens “C” in the US and finally undocumented Mexican Immigrants “U” are included.

For the Mexican states, it was decided to include the specific year or time to record the number of Mexican immigrants coming from each Mexican state. The other data attribute for the Mexican table included was the decade event to represent if any significant historical event is responsible for these movements of people. While the Mexican table proved to be a series of just three attributes, the US table had a series of seven new added attribute data columns.

Furthermore, about what this data is about and based on will be explained in the 3.2 Data background section. To conclude the 3.1 Database Design and construction section, the overview process took approximately less than two hours of just finding the correct shape files and adding attribute data columns to each table.

3.2. Data Requirements/Data Sources

After designing and organizing the attribute rows of each table and understanding what is needed for the HMMGD it came time to decide data availability and fitness-for-use. This section contains two subsections to better understand the breakdown and considerations of the data.

Section 3.2.1 provides a breakdown on how Mexican culture data has been recorded and

interrupted throughout time, and Section 3.2.2 explains the data sources. When looking at historical data base on identity, it becomes a very complex history. When uncovering past records of counting methods in the past there will several obstacles that a data collect will stumble on and will have to overcome how to properly exact this this information for a project. This because identity has changed throughout time, semantics, influences and perspectives of the time, have shifted how we define the terms race, ethnicity, gender and color, The following sections will explain how these obstacles were come and why they so important to take into account for the HMMGD.

3.2.1 Understanding Mexican Data

To understand the data that this database focuses on one must understand the history of Mexican identity in the United States. Since the data primarily focuses on a specific culture/ethnicity it is important to realize how this data is recorded and ensure that, the proper methods of interpreting the data are performed. Data based on identity can often be challenging to find the right data due to certain data institutions that often do not give a proper breakdown of captured data. Umbrella terms such as race categories in the US can create dilemmas when finding one specific dataset based on a culture/ethnicity. In the early 21st century, the United States recognized Mexican people as Hispanic or Latino; which at times depending on the recording method of census and other statistical reports can be a race or ethnicity to be included with the other people/culture of Latin America.

Fifty years ago, this would not be the case. As the term Hispanic was not used in 1960 in the U.S. census. Prior to the 1980's Mexicans were recorded as being white despite Mexico being a multi-ethnic country (US Census Bureau 1960). It is important to realize that throughout time identity has changed based on the social status, and interpretation. Since the temporal frame

of this database is from 1850-2015, there was a variety of definitions of how the term Mexican was recorded. But to ensure that the data from various times is recording the same people, rest assured that all the data focused on the people from one geographic location. Origin the nationality/culture/ethnicity of Mexican has been grouped under different umbrella terms.

After establishing that database, the umbrella term Hispanic or Latino could not serve as a legitimate source to recognize true Mexican data. Despite that Mexican-Americans make up over 60% of the Hispanic population in the United States, it would not be practical nor reasonable to assume that all these Hispanics are Mexican descendants. (American FactFinder 2015) More on the data background will be discussed in the interpreting Data section below. Perhaps one of the biggest challenges creating a collaborative database is validating the information imported into the database or simply data validation. Data validation is a vital process to ensure that the data acquired is properly organized and interpreted by the database's parameters. A challenge in creating a database on migration is locating the data and taking the information that can be useable.

Secondly, without properly setting parameters on how the data was captured and various datasets despite being very similar can and are acquired differently based on the process of data capture. Semantics and language was an obstacle to overcome in creating this database. Various institutions have their own way to record information that can in fact be the same topic however due to interpretation and on time data from this institution can create some issues when comparing datasets. One example is the US Census Bureau. The US census bureau has become a wealth of information; both researchers and policy makers rely on its data. The tools and practices of GIS have gained a lot of success from the US Bureau.

Despite this wealth of knowledge, the US Census Bureau is a large source of data that when breaking down the section of precious census one can see some issues how and what the US Bureau includes and excludes. For the purposes of this database, one main goal was to see if one could find Mexican immigrant numbers and Mexican American population. What could be found easily was the Mexican immigrant numbers but only at a national level. When breaking down at a state level, the numbers appear to be missing or simply substituted for foreign born population in each state. A substitute to find Mexican immigrants per state was found in a Migration Policy Institution map based on data from the American Community Survey however only between the years of 2010 to 2014. A sample of this data was based on the Migration Policy Institution and the Pew Research Center article: *“From Ireland to Germany to Italy to Mexico: How America’s Source of Immigrants Has Changed in the States, 1850 – 2013”* was able to provide an estimate of Mexican immigrants as the highest immigrant culture at state levels per decade from 1850 to 2010.

When it came time to find the Mexican-American population throughout the decades, it became challenge and acceptance of how the United States recognized and changed identity throughout time on their census’. Despite most of Mexico’s population being Mestizo (Mixed indigenous and European) and still a large presence of indigenous and European descendants along with minority populations of African and Asian ancestry. Until the 1970’s the United States Census recognized Mexicans as part of the white race. Throughout much of Mexico’s colonial past, Mexico’s white or European ancestry compared to the Mestizo and indigenous remained as the third highest ancestry (Meyer, Sherman, and Deeds 2011).

Nevertheless, Mexicans/Mexican-Americans living in the United States were recognized as white, except for one decade where in 1930 Mexican was recognized as a race. 1,282,883

individuals recognized themselves as part of the Mexican race in 1930, interesting enough 1930 was the same time as the Mexican repatriation. Where an estimated 600,000 to a million Mexicans and Mexican-Americans were deported to Mexico due to the economic crash of the 1929 stock market. Where 2/3 of the estimated deportees were American born. (Acuña 2007) Ten years later, the 1940 census did not have Mexican as a race but reports of Spanish surnames were recorded in selected Western US states. This trend continued into the 1970 census (1960 US Census).

Year	Immigrants from Mexico	Mexican American Population	Notes
2015	11,643,300	35,797,080	
2010	11,711,100	32,929,683	
2000	9,177,500	20,640,711	
1990	4,298,000	11,580,038	
1980	2,199,220	8,740,439	Year Census recored Ancestry
1970	759,700	4,532,435	
1960	575,900	3,464,999	
1950	451,400	2,281,710	Census reported Spanish Surnames in certain Western States
1940	357,800	1,570,740	
1930	651,500	1,282,883	Mexican was considered a Race
1920	486,400	<null>	
1910	221,900	<null>	
1900	103,400	<null>	
1890	77,900	<null>	No State Recording Method to record Mexicans/Mexican-American
1880	68,400	<null>	
1870	42,400	<null>	
1860	27,500	<null>	
1850	13,300	<null>	

Figure 7. Numbers of Mexican immigrants and Mexican American population 1850-2015 from US Census

This numbers however before 1970 recognized Spanish surnames only in the States of California, Arizona, New Mexico, Texas, and Colorado. In the 1960 census Spanish surnames were breakdown into native and foreign then Mexican Parentage, Born in Mexico, mixed and other. It was not until 1980 where the United States officially started to record its citizen's ancestry. This gives this database a four-decade period to see the growth of the Mexican-American population (1960 US census).

3.2.2 Applying the data

After understanding the background of Mexican data in the forms of identity and semantics, it was now time to incorporate the data for this project. One of the most essential data components was acquiring population data then being able to associate that data with a certain state. The US Census Bureau provides most of the data that can be converted into spatial data however for this project only the Mexican-American population was applied to each state for the decades of 1980, 1990, 2000, 2010 and the year 2015 was collected from the American Community Survey where some states did not provide the Mexican-American population.

Since the year 2015, did not have all the states numbers of their Mexican-American population record, these states were recorded as <null> or unknown in database terms. It was then later discovered that the data from 1980 only included Americans of full Mexican ancestry, there is a partial ancestry data sheet that may be added to these numbers in the future. These decade and year datasets were transferred into their specific names field 1980_MAP, 1990_MAP, 2000_MAP, 2010_MAP, 2015_MAP. Following the other decades and 2015, data reported anyone that identified as Mexican-American full or partial. The Migration Policy Institute (MPI) provided data for the number of Mexican immigrants in each state for the fields C20102014, U20102014, MI20102014.

These feature classes represented the attributes of all Mexican immigrants, naturalized citizens, and unauthorized immigrants, all three between 2010 to 2014. MPI also supplied the number of immigrants from each state from the year 2004 to 2015 whom they received these numbers from the “Encuestas sobre Migración en la Frontera” (EMIF 2013). After exploring the EMIF data it was then possible to find data before 2004. After contacting the EMIF the furthest

data available to find Mexican immigrants from each state was a period of 1993-1994. EMIF supplied numbers from 1993-2004 and single years from 2004 to 2015. These datasets provided this project with estimated numbers of Mexican immigrants both in the US and from Mexico states.

The Pew Research Center then provided a historical timeline map that could find the highest immigrant by state map from 1850-2013. Since this project only focuses on Mexican immigrants it was decided to map this information numerically the numbers 1 and 0 would be used. Each decade created an attribute column inside the database and were numbered according to the Pew Research Map. The number 1 representing Mexican while 0 represents other immigrant cultures this method would allow better performance in SQL statements; this example will be provided in the section 3.4. The Pew Research data was applied the “decade_HI” fields to represent highest immigrant, 1890 data was not available as according to the Pew Research Center there was a fire that destroyed the 1890 census documents.

Once finishing the numerical data, it was time to focus on how to incorporate any historical information that could be easily converted into statistical data. The following paragraphs will include how historical events were recorded into the HMMGD. Data for the columns “decade”_event and “decade”_work were acquired by literature data sources that could be associated with a state. These sources included a wide range of academic fields that were related to Mexican migration, Books such as *The Course of Mexican History* by Michael C. Meyer William L. Sherman, and Susan M. Deeds *Occupied America a History of Chicanos* by Rodolfo Acuna could provide these text data types for this project. These sources were then applied to selected states that may have been affected by history or an industry.

For example, the Bracero Program of 1942 may have only occupied the Western United States whereas the southeast states did not receive Mexican immigrants. More modern current events came from news articles that reported impactful immigration bills, such as Arizona SB1070 and Alabama HB 56 would only be associated within their own state (Fausset). The same method was applied to the “decade”_work column to show Mexican workers in US industries. These literatures include Mexican American Labor 1790-1990 by Juan Gomez Quinones, and Traqueros by Jeffery Marcos Garcilazo. One example of using these methods was applying Traqueros data to US States. Marcos stated that 2/3 of the track labor force of the southeast, central plains and Midwest were Mexican workers (Marcos 34).

The major railroads that hired Mexican immigrants were the Southern Pacific, Atchison Topeka & Santa Fe and Union Pacific. Therefore, one could pinpoint what states these immigrants were in based on what time or decade the railroad lines were built in. Railroad maps and history books of these railroads provided that information. Examples of these sets of data will be shown in section 3.3 too, in the form of a symbology map examples after explanation the process of importing this data into ArcMap.

3.3. Procedures/Analysis

After the data was found it came time to find a way to present and validate this data from literature and intuitions sources. The most efficient way to do so was to organize this data into multiple Excel spreadsheets, transfer these spreadsheets, and visualize the data. The spreadsheets were then organized into separate original files associated with specific groups. Once recording a dataset from a source in an Excel sheet, the Excel sheet data imported into ArcMap and joined

the feature table class after selecting the edit and attribute column. This became a very easy option to import the large amounts of datasets a times to ensure data validation and no errors.

3.1 Thematic Analysis

Since one of the main goals of this project was to use thematic maps to map the time and spatial events of Mexican migration. A variety of different symbology maps were created to ensure if there were any mistakes that could be easily noticeable on graphical image than on a pure data table. Numerical data worked best with quantities symbology while category symbology worked best with unique values as seen below in Figure 8. Figure 8 shows a conceptual map of what industries in 1900 used Mexican labor in certain states. The pink states represent the industries of railroad, agriculture, and mining, while blue indicates railroad and agriculture, green represents railroad and lastly the tan color represents <null> or unknown data that has not been determined yet if there was a large presence of Mexican labor in those states.

Three Industries that Used Mexican Labor 1900

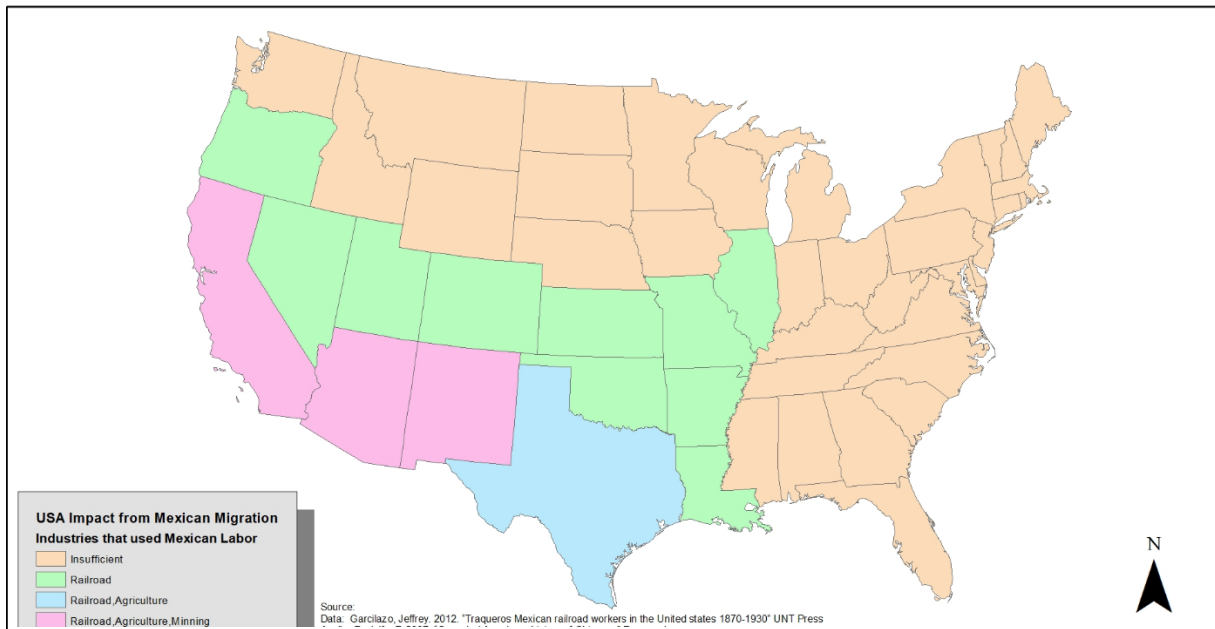
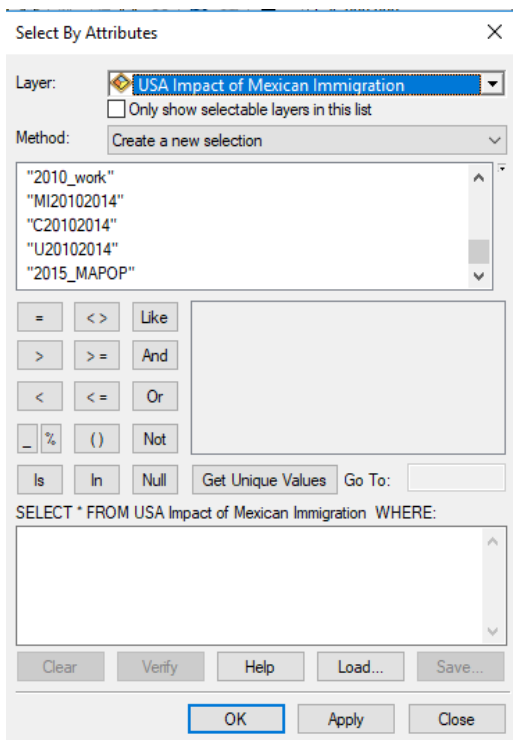


Figure 8. Three Mexican Immigrant industries in the US 1900

Future research could solve these <null> values if in fact there was no large Mexican labor presence or add or edit any other industries in certain US states. After seeing successful examples of symbology maps, it was then time to turn the attention to see how the data could be used in SQL statements.

3.2 SQL Analysis

One of the main features of ArcMap is the ability to use a built-in SQL query builder that is easy to use in the interface of ArcMap. Once selected under the Selection tab the Select by



Attribute command opens the SQL query builder. Within this dialog the magic of SQL statements can be performed. The top layer pulls up allows the user to select which layer or table. From there, the user can then select which attribute column to select to start a SQL query.

After performing a series of SQL queries the HMMGD found several simple commands that any user could use for their research on Mexican migration. Essentially the database performed multiple query tasks from all the datasets and extracted this data in the form of maps for comparison. By performing SQL statements this will ensure that the goal of a geospatial database is feasible and able to produce data results

Figure 9. SQL Builder in ArcMap

and not just static non-interactive tables.

- The number of Mexican immigrants in a U.S. state. (2010-2015)
("Mexican_Im" > 1000000) vs ("Mexican_Im" < 1000000)

The SQL statement above is a simple statement example that can easily answer which U.S. states have the largest/smallest number of Mexican immigrants in the U.S. from a fixed time interval of 2010-2015. In this case the sample code indicates “Mexican_Im” as the Mexican immigrant field > < greater of or less than 1,000,000. The same produce could also use =, .>=, <= operation if any of the states had exactly 1,000,000. The result from the comparing the > and < operations shows that only California and Texas had over a million Mexican Immigrants while the other 48 showed they had less than a million. The same type of statements below will have a similar code. The questions below represent potential topics of interest to users of the database:

- States with the highest number of Mexican immigrants.

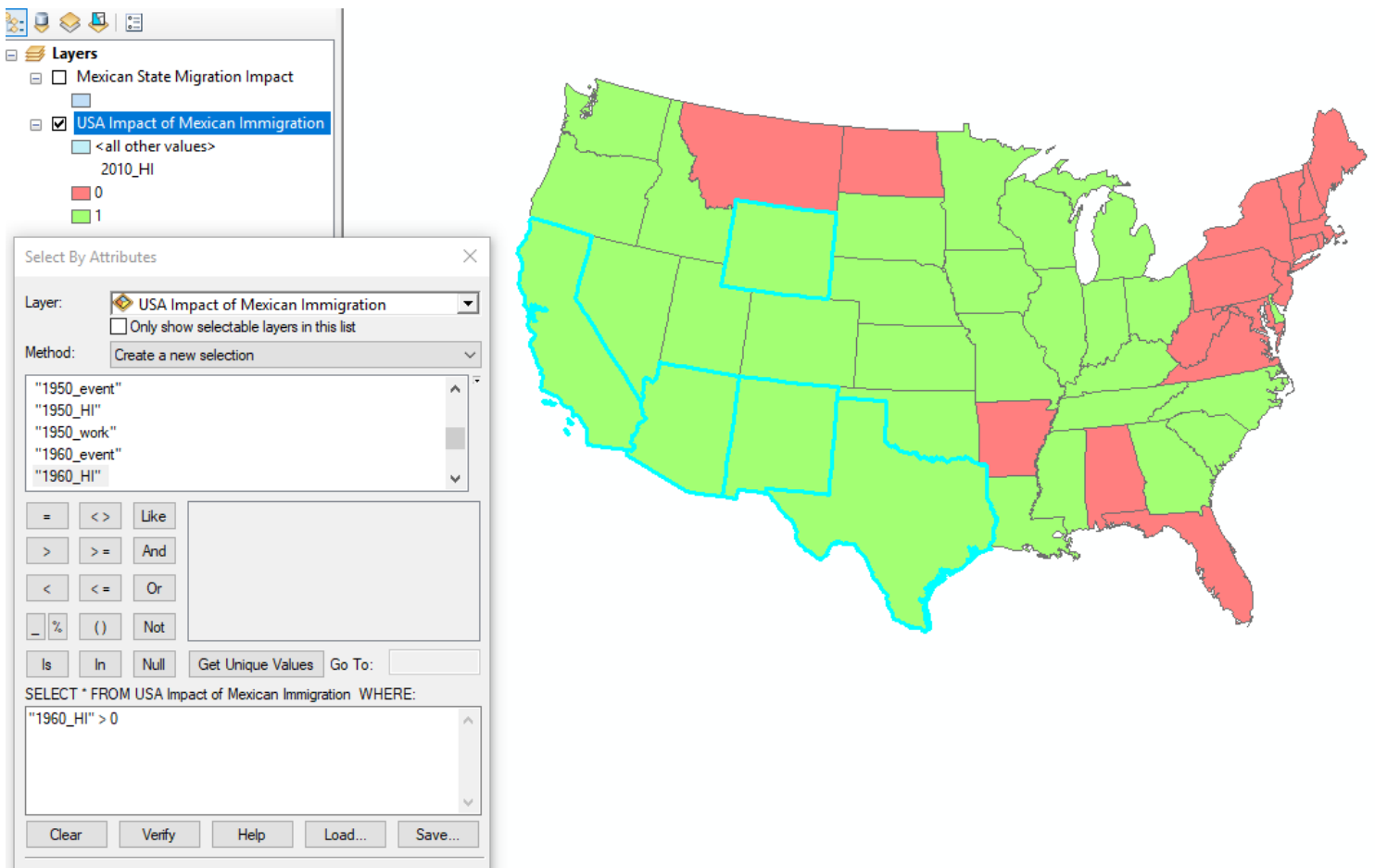


Figure 10.. SQL results of 1960_HI > 0 (highlighted states) and then comparing a 2010_HI map symbology, (Green = 1 “highest immigrant” Red = 1 ‘not highest immigrant”)

- Mexican States with the most immigrants coming to the U.S. within a timeframe
- Mexican states with certain number of immigrants by year
- U.S. states that have the highest Mexican-American population
- States with the highest number of Naturalized Mexican immigrants

After testing these examples of SQL, ("Mexican_Im" > 1000000), ("Mexican_Im" < 1000000) , and ("1960_HI > 0") the process of exportation will ensure that Mexican migration data can be shared for its intended users. This step allows the users to create multiple maps based on the SQL results. The results can then be reflected on a map, which can become the easiest form of sharing. The SQL end results will allow the user to cut or section a certain portion of the data and then.

Chapter 4 Results

This Chapter discusses the results of the development of the database and feedback from various academic scholars who have a background related to the project. The results of the HMMGD provided several positives via maps from performing SQL queries and symbology maps. This database is worthwhile for many different scholars in many different disciplines. In this section, two case studies are provided to show four symbology maps based on the spatial data contained within the database. The narrative of these two case studies are followed by the reports of five academic professionals who provided evaluations and feedback on the usability of the database.

4.1. Case Studies

The two case studies are discussed below to show the results of specific questions with respect to Mexican Migration both in Mexico and the United States. One case study shows a comparison of two years of the number of Mexican immigrants coming to the US from each Mexican state. While the other case study shows another comparison of the Mexican-American population growth between two different decades. These case studies were performed to show how the HMMGD could perform maps to see migration patterns base on the data inputted in the database.

The two case studies ask what major patterns of migration or growth base on this migration has changed during a certain time. To show these patterns both case studies used choropleth map to order to show the amount of a value according to the state area. And proportional were also used to show a comparison of where certain population are more constricted then others. The first case study asks did the 2007-2008 US economy crisis affect Mexican migration within a five-year period. Case study two asks what regions or states in the

United States have had significant a Mexican-American population growth and could this growth be driven by industry demand. The results of these cases studies are presented in the following paragraphs.

Case Study One: Mexican State Migration to the US 2006-2013, shown in the maps below can graphically view spatial migration data in the 31 Mexican States and Mexico City (CDMX) polygons. The period of 2006 and 2013 were chosen to see what the numbers of Mexican immigrants from each state were before and after the 2007-2008 economy crises. If there were any major differences found within this period, then it may hold truth that the 2007-2008 economy crash had a significant impact on Mexican Migration. It may also be worth mentioning that other events may have also influence these numbers for example perhaps the Mexican economy has improvement. Once looking at the overall data, the study can then see which states were most affected by during this time.

In the case for 2006, the data summed up all the state and CDMX numbers which reported that 815,900 Mexican immigrants came to the United States. The numbers from each state was then categorized in 5 percentage ranges: <1%, >1%-2%, >2-4%, 5%-9%, and 12%-14%. Two states Chiapas and Guanajuato represented the highest percentage of 12%-14%, while The states Mexico, Michoacán, Oaxaca, and Veracruz fell in the second highest range of 5%-9%, while most of states were in the >2-4% range. When analyzing this map, the numbers are a surprise to see that the two most populated areas of Mexico, CDMX and the State of Mexico were had a lesser percentage then the sixth, seventh states. Smaller populated states gave reason why they did not produce as much however other less populated states did show significant numbers even far away from the US-Mexico border.

The Number of Mexican immigrants to the US by Mexican State 2006

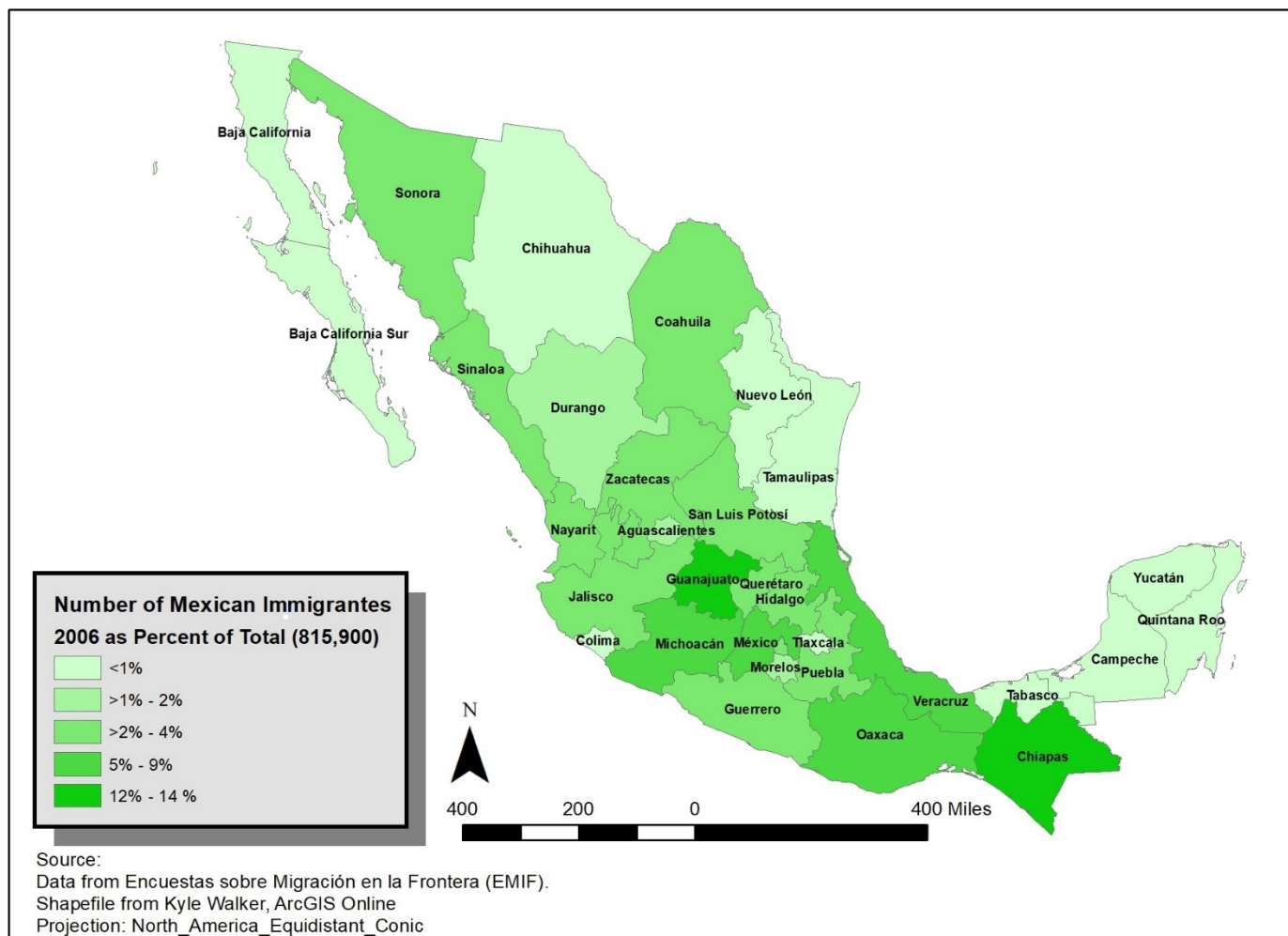


Figure 11. The percentage of Mexican Immigrants to the US by Mexican State in the year 2006

The Number of Mexican immigrants to the US by Mexican State 2013



Figure 12. The percentage of Mexican Immigrants to the US by Mexican State in the year 2013

In the case for 2013, the total number of Mexican immigrant to the United States decreased to 322,900 more than half from the year 2006 the percentages of 2006 were also applied. The highest states with the most immigrants to the US was shifted to the pacific southwestern states with the expectation of Colima and nearby central states and the southern state Chiapas that now range at 5%-9%. Most of the other States show percentages at >2%-4% mostly in the Northern Sates and Veracruz which was drop significantly from 2006.

To further assist to see the trends of Mexican state migration two proportional maps were also created to see another perspective on which areas within Mexico had the largest concentration of Mexican immigrants by number ranges of 100,1000,5000,10,000 and 100,000. These proportional numbers were represented by circles that range from small to large base according to the number ranges. The 2006 proportional map shows largest numbers throughout the Mexico while the 2013 map is concentrated in the west and central, this time however the proportional can see a better comparisons of numbers between the states.

After comparing and using GIS spatial analysis relationships of the two choropleth maps between the states and years, there is a confirmed major shift of Mexican immigrants coming into the United States before and after the US economy crash. To add further to these reasons behind these shifts, scholars could explore other events that may have impacted this period by adding data in the 2000_event and 2010_event data columns of the Mexican and US tables. Other data could be added to see if any industries were affected by this period such as the construction or food industry. With respect to further research, scholars could focus on states within Mexico that saw the greatest change and then perhaps trace it to an event. For example, did Chiapas produce more immigrants then Sonora because of the State economy?

The Number of Mexican immigrants to the US by Mexican State 2006

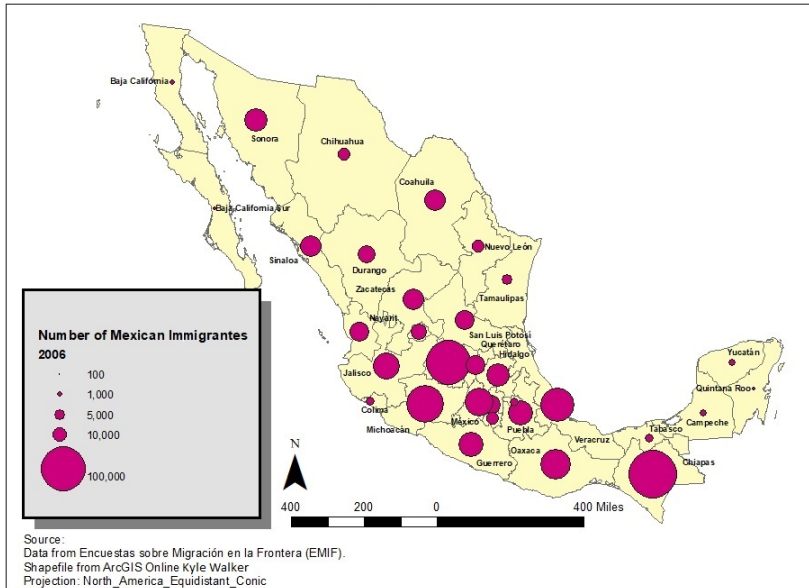


Figure 13. Proportional map of the number of Mexican immigrants to the US by Mexican State 2006

The Number of Mexican immigrants to the US by Mexican State 2013

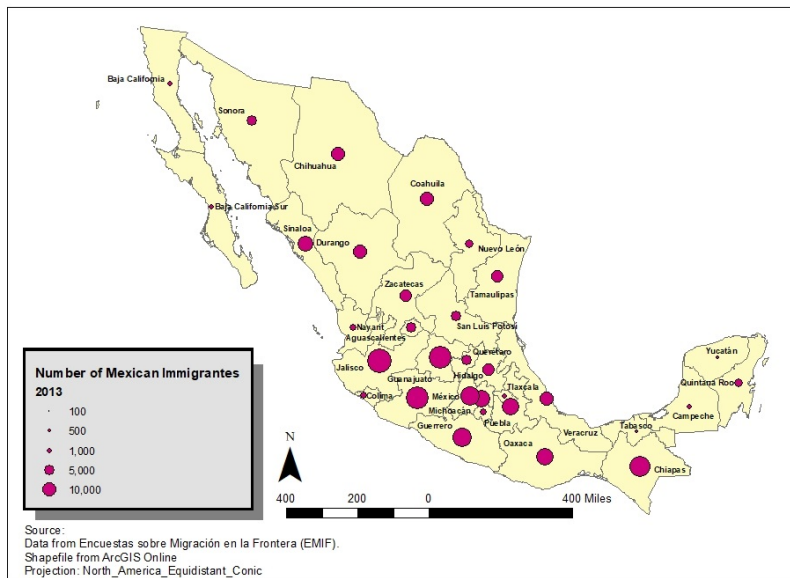


Figure 14. Proportional map of the number of Mexican immigrants to the US by Mexican State 2006

Case Study Two Mexican-American Growth Patterns 1990 vs 2010 looks at differences in the growth of the Mexican-American population between 1990 and 2010 in the United States. The choropleth maps were not used as the final byproduct of the case study, but to ensure that the final appropriated map was guided in the right direction by looking at raw numbers first that would be adjusted. This data came from the US Census Bureau based on individuals who identify with having Mexican ancestry. These individuals would be considered Mexican-Americans, namely US citizens who identify as having ancestry from Mexico. These numbers may even include the direct descendants of the original estimated 50,000 Mexicans who lived in the once Mexican territory or modern day Western United States before the Treaty of Guadalupe Hidalgo.

Due to the long history of a Mexican presence in the American Southwest or inherited culture because of the Mexican-American War the United States has been witnessing the growing Mexican-American population from incoming immigrants who have settled and started families with their American born children. These maps look at a byproduct of the impact of Mexican immigrants in the US. These maps analysis those Mexican immigrants of those who have acquired US citizen and their American born children. Historically the Mexican-American population has remained and assumed to predominately be in the American Southwest. Yet according the data from the HMMGD 1980 saw the Mexican-American population expanding outside the American Southwest, three states- Illinois, Michigan and Washington- stand out as having significant numbers of a Mexican-American population. 1980 seemed to be a significant change the Mexican-American population began growing in newer region in the US. Fast forward to 1990 we see greater numbers in previous nontraditional states outside in the southwest. A 1990 and 2010 choropleth map both show tan to brown shades throughout the US

Mexican-American Population in the 48 US Continental States 1990

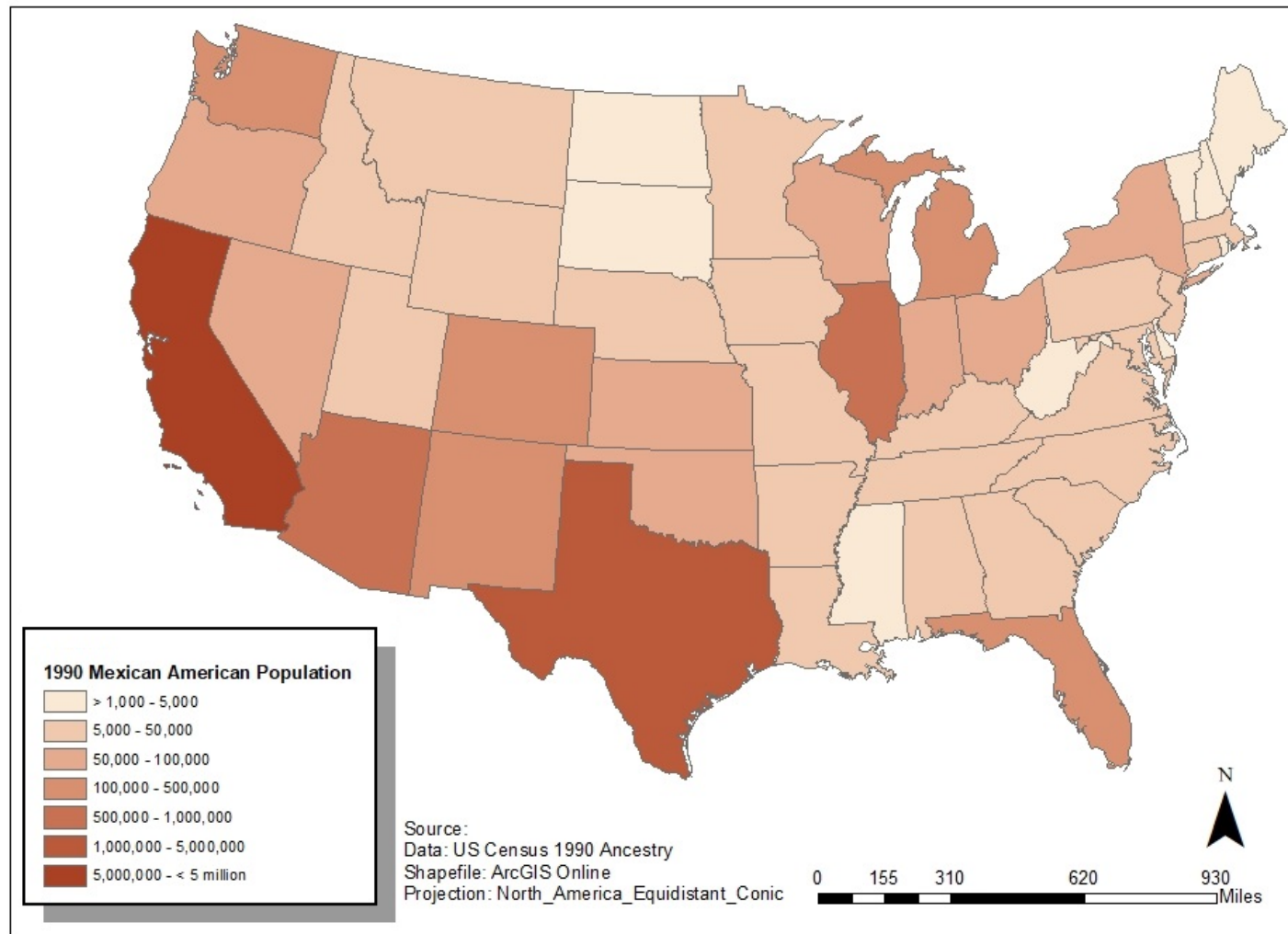


Figure 15. Mexican-American population by US state 1990

Mexican-American Population in the 48 US Continental States 2010

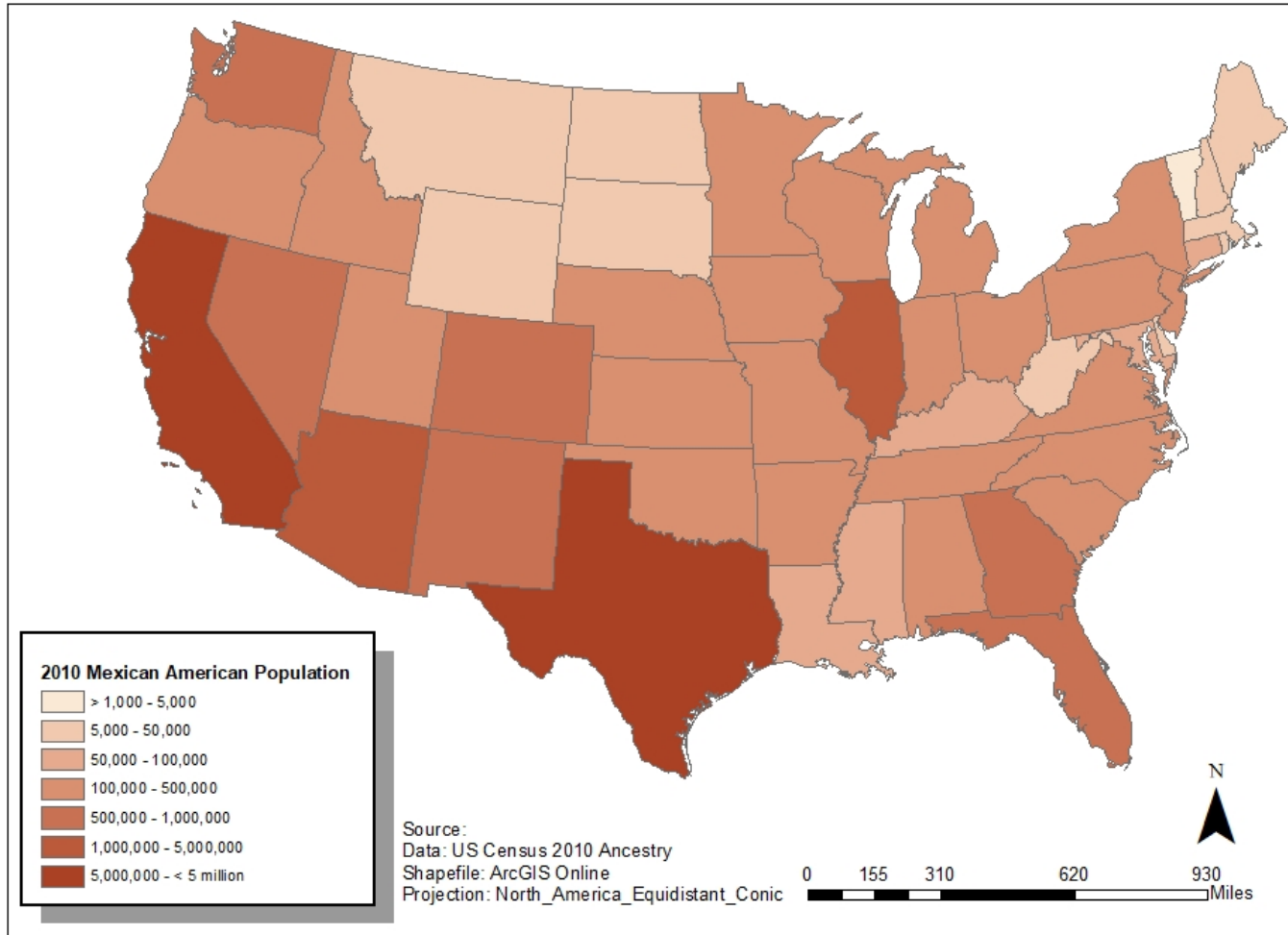


Figure 16. Mexican-American population by State 2010

representing the states with the highest Mexican-American population. These maps ask what areas has the Mexican-American population has grown within twenty years and why?

By comparison there has been a major increase within the Mexican-American population from 1990 to 2010. In 1990 according to the legend we see that California and Texas had over a million Mexican-Americans while states such as Illinois, Arizona, had a range of 500,000 to under a million while, New Mexico, Colorado, Washington, Florida, and Michigan. had numbers in the 100,000s. Meanwhile Nevada, Oregon, New York, Kansas, Oklahoma, Wisconsin, Indiana and Ohio show numbers above 50,000, the rest of the US states are under 50,000 to as low as under a 1000 in states like Vermont and West Virginia. The Mexican-American population in 1990 shows a major concentration in states of the Southwest, Pacific, Midwest, and New York and Florida outside those regions.

By 2010 there is a greater significant change in regions, but also certain states have surpassed other states than before. A further break down of this population is seen in a 2010 proportional map seen below on page 42. Regions such as the Southeast, Northwest and Midwest have had significant growth. The southwest continues to have the most concentration of Mexican-Americans. As now Texas joins California in the 5 million and above range. The southeast is experiencing a higher Mexican-American population as now Georgia, Virginia, Alabama, the Carolinas, and from before Florida have all experienced numbers higher in the 100,000s. Out of the continental US only Massachusetts, Wyoming, Delaware, Montana, South Dakota West Virginia, North Dakota, Rhode Island, District of Columbia, New Hampshire, Vermont, Maine, have less than 50,000 Mexican Americans. Nevertheless, these populations have still doubled their Mexican-American citizens since 1990.

To further make this case study more appropriate the final map for this case was to combine the two decades and see how the Mexican-American population has grown by dividing the 1990 data with the 2010. This would allow the data to be normalized and see how much growth there has been in the regions of the U.S between the two decades. The ranges were from 2.14–4.00, 4.00–7.00, 7.00–9.00, 9.00–12.00, and 12.01–19.73. The results were stunning to see a

Mexican-American Population Growth in the 48 US Continental States between 1990 and 2010

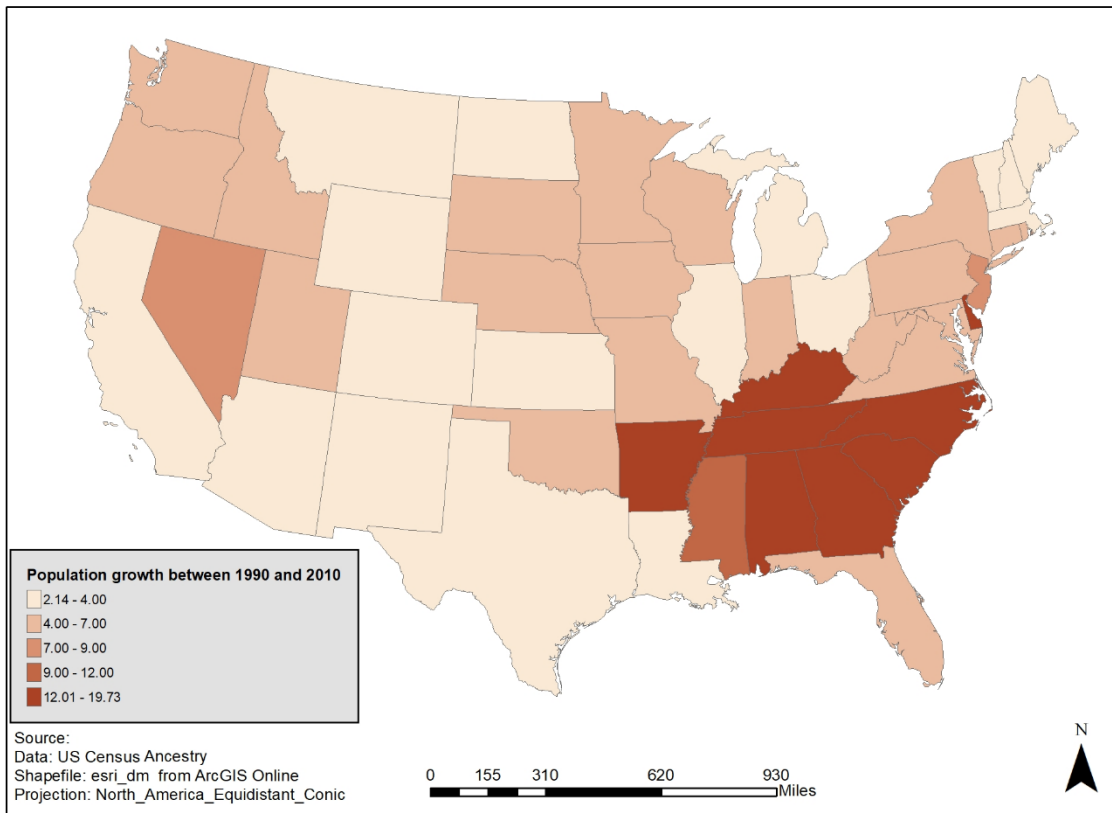


Figure 17. Mexican-American population growth between 1990 and 2010

significant growth in the Southeast. No U.S. state had a decrease in their Mexican-American population all the states had more than doubled. California range in at about 2.14 Mexican-American population from 5,322,170 (1990) to 11,423,146 (2010). North Carolina with a

population of 486,960 Mexican-Americans had the largest increase of 19.73 times of what it had in 1990 at 24,685.

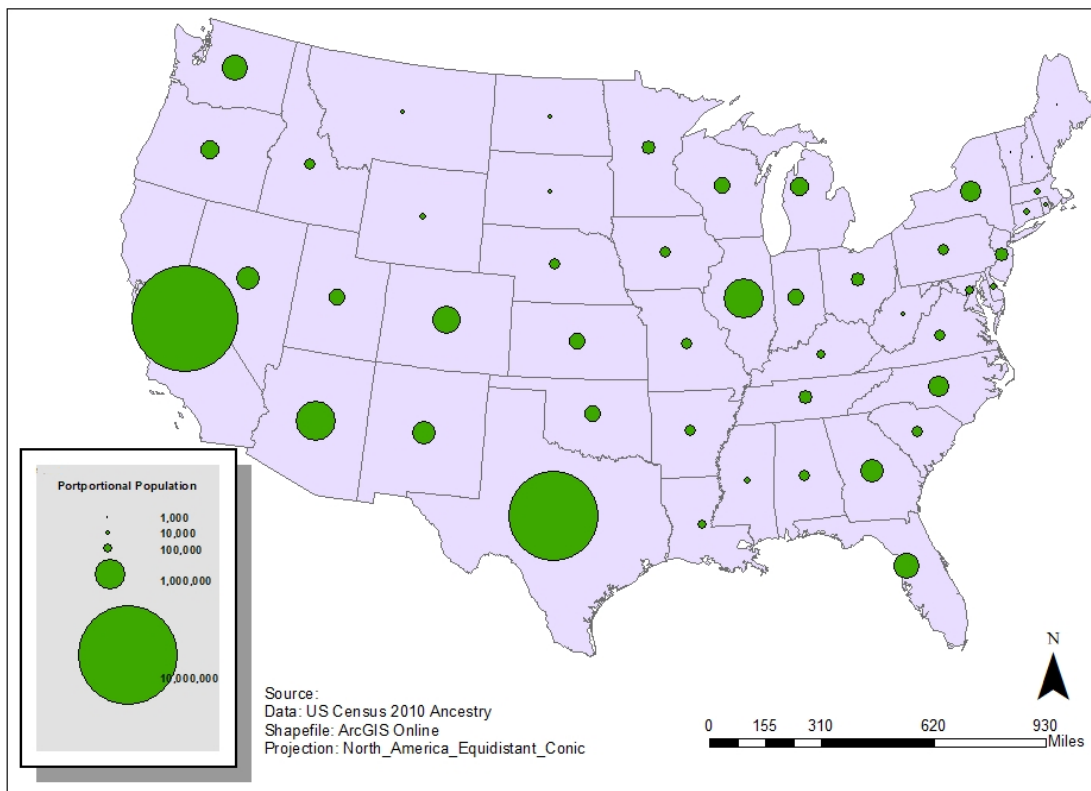
Seeing these spatial changes what allow or influenced these Mexican-Americans to expanded and grow much rapidly than other US states what was the location preference and why. Closeness to the Mexican border may have been the case the prior to the 1980's however a large presence of a Mexican-American community was already established in Illinois and Michigan, in 2010 we see states such as Idaho, Georgia have a newer presence of a Mexican-American population. Now that Spatial analysis can find these regions of where there is a Mexican-American presence scholar could now identify why some states attracted or grow more rapidly than others.

Perhaps the best reason behind this trend is local industries that attracted both Mexican immigrants and Mexican-Americans. States it may be logical to say that the Mexican-American population in the Southwest has the most Mexican-Americans because these are states along the US-Mexico border and there were even descendants of the originally 50,000 Mexicans who lived there before the Mexican-American war, but even so labor demand was a major reason behind the growth of the modern Mexican-American population. Data from the HMMGD in the work data columns will indicate certain industries that hired Mexican laborers. The Southwest attracted many laborers from Mexico to work in the railroad, mining, and agriculture industry. States in the Midwest then attracted Mexican immigrants to work in the railroad industry which may be the reason why there are so many Mexicans in a non-boarder state like Illinois then perhaps other industries such as the automotive industry attracted Mexican immigrants to work in Michigan. For states like Idaho, Alabama, North Carolina, Virginia and Georgia perhaps agriculture attracted Mexican immigrants.

These types of correlations between location preference and local industry may hold worthily to show the byproduct of Mexican immigrants and their American born descendants, this therefore shows the direct impact of Mexican migration not only in the American southwest but throughout the United States. These were just two case studies scholars can research in the HMMGD, other aspects and further questions could be asked in the future.

An additional feature within ArcMap that user could explore would be the animation and time slider tools. These tools were both tested for both case studies yet appeared to not be correctly format to properly use these features. A future would be to explore these features and

Mexican-American Population in the 48 US Continental States 2010



created a time amination of both two case studies.

Figure 18. Proportional map of the Mexican-American population, showing the concentrated areas of Mexican-Americans in 2010

4.2 Feedback

After this database was compiled and two case studies were developed as examples of its capacity, the HMMGD was tested by experts who have studied in Mexican Migration from different disciplinary perspectives. These experts were experts in the fields of anthropology, history, ethnic studies and geography. A range of scholars were researched, chosen and contacted individually by email to be consistent with the project's objective of the database being accessible and accessible to academics within a variety of fields. With the expectation of one individual, this database was not shown face-to-face as traveling to each individual location and showing the project from a laptop was not practical. Thus, the database was introduced remotely.

Experts had two options to view the database on their own personal computer system, either via a YouTube video or by remote access. A 17-minute video was uploaded to YouTube which screen captured the HMMGD within ArcMap. This allowed two users to view the overall goal of the HMMGD at their leisure and avoid any technical problems with remote access. Two users downloaded Google Remote access and entered a generated code that gave them access to view the HMMGD. A phone call was also conducted to gather direct feedback as to the functionality of the database. While one scholar was met in person and was presented to the project through a laptop.

The following paragraphs discuss the feedback provided by each user (additional information is provided in Appendix X). The first tester was an assistant professor of History from the University of Fort Hays State University and explored the database via remote access on October 30, 2018. This professor has focused on Mexican history from 19th century to modern times with an emphasis in the Mexican Revolution, a time period that really covers Mexican migration into the United States. In his letter of support, he stated that the HMMGD's

“practicality and easy functionality make it a pioneering resource to explore the presence of migrant communities in the United States.” His area of study made him most interested in the migration flows of the 20th century and why certain areas in the US attracted Mexican immigrants versus other locations. One of the main aspects of ArcMap allowed this professor to appreciate the visual customization or adding data in the future. One of potential future capability, suggested by this user, was to add counties/municipalities in both the US and Mexico.

The second scholar to provide feedback from an associate professor at the Mexican American & Raza Studies Department at the University of Arizona. The introduction to the database was conducted on November 2, 2018, at the University of Arizona at a coffee shop. This scholar has conducted extensive work in Chicano studies, journalism, indigenous cultures, and migration. After reviewing the project, the scholar saw potential projects in his research that could use the same concept and may be integrated. Such as creating a Maiz/human migration in the Americas and tracking law enforcement or official violence in the United States.

The third tester was contributed by a curator of Ethnohistory and a professor in the department of history at the University of Arizona. This introduction was conducted on November 19, 2018 and done via remote access. This professor found the HMMGD useful for his teaching and research. He discussed ways in which his students could write papers-based questions they could answer via the data contained in the database. With respect to his own research, he was interested in tracking Mexican migration spatially and temporally between certain states in both the US and Mexico. He found one positive aspect of the database to be the accessibility and searchable data attributes. He also suggested that a variety of professional scholars and entities might be interested in the database, such as non-profits, policy institutes,

and policy makers. This professor also provided literature sources that could be added to the database.

The fourth tester was a former social studies educator with a geography background. The testing was conducted during the week of the November 26, 2018. Due to technical limitations, the functionality of this database was demonstrated using a YouTube video. This user reported that the HMMGD is a valuable tool for the geospatial analysis of statistical data. He/she also reported that the database visualized Mexican migration patterns in a way that could be applied to other culture migrations as well. This user suggested that the project could also bring value to educators in the fields of geography, history, civics, economics and sociology. He/she suggested that with the use of ArcMap, a student could create their own custom maps. The user also mentioned that they are a local political party chair that could foresee themselves and others benefitting from such as tool for on-demand data to better understand migration in their local demographics. From a geographic standpoint, this user would like to see a wider range of regions and sub regions and surnames for the different time periods.

The final tester was a cultural anthropologist and professor from the University of Arizona. The database testing was conducted during the week of November 26, 2018. The project was first introduced via a 15-minute phone call to give the overall scope of the project. Once explaining the overall scope of the HMMGD the conversation expanded into other topics from this migration that may be added in the future such as looking how indigenous Mexican migration plays part in the migration within both US and Mexican states. The project could also lead to help create a database for central American migration. After the phone conversation was over a YouTube video was presented and their feedback in the following. The database is an excellent idea and the data is well organized accessible for uses to create maps to teach and

research. The database was also quoted by this individual as “This database is useful for correlation historical events to migration patterns. I would like to see this expanded to Central American countries as well. This work allows us to see the micro-events that drive at least some of the migration and connect them to larger processes.”

Once gathering five feedback reviews from professionals in different fields, who came to test the database from within their different academic perspectives. All testers found the HMMGD useful within the context of their own disciplines. The HMMGD proves its worth in researching spatial patterns in Mexican migration. The only requested addition to the database was common among all the testers. This commonality was adding data in the future yet some of the feedback was from a variety of different areas of focus. Focuses such as law enforcement, counties municipality, local demographics data were expressed and maybe possible to add to the HMMGD. Certain individuals also saw these same methods could be practical to be apply for other migrations as well.

Table 4. Code Expert Table summarizes the scholars and user feedback

User	Profession	Feedback	Types of usage	Future Addition
1	History Professor	Positive	Could help indicate how industries attracted Mexican immigrants to certain states	County data
2	Mexican-American Studies Professor	Positive	Tracking ancient Maize migration	Law enforcement violence data
3	History Professor	Positive	Tool used for both students and professors	County data
4	Geographer teacher	Positive	Demographics	County data
5	Anthropology Professor	Positive	Great to connect historical events with migration patterns	Central American migrations

*Positive feedback was determined by the evaluators supporting aspects of the database

Chapter 5 Discussion and Conclusion

Chapter 5 discusses the future goals of the HMMGD as well as concludes the research project.

Overall the project meets its satisfied quest to create a system to allow users to ask questions about Mexican migration and perhaps tie these questions with historical events. The HMMGD was also approved by five academic scholars and users who saw great promises with this type of technology. Two case studies were also performed successfully to see how users could perform such questions in the database. Although these case studies were demonstrative and not fully conclusive they do provide help where professionals in migration to make these questions conclusive. A user of this database can view data from a temporal range of 1850 to 2015 and create maps using SQL programming language and symbology. These maps could then be providing the basis for a more in-depth migration project.

There are several remaining goals this project could fulfill in the future. The biggest component that could be added to this database is data as there is still a large amount of information about Mexican migration that could be added. One example would be to add data sources that could provide Mexican Migration state numbers before 1993. To find this data, one could look at immigrant programs that recorded the origin of state if there are census reports from the Bracero program from 1943-1963. Other than the Bracero program, perhaps local country or city data may provide this information. Currently this information is scattered and would take a long time to compile after going through several different records. Fortunately, this database doesn't have to end, the data within this database can be reused again and adjusted when updated data is available. There is also room to create the HMMGD into a relational database.

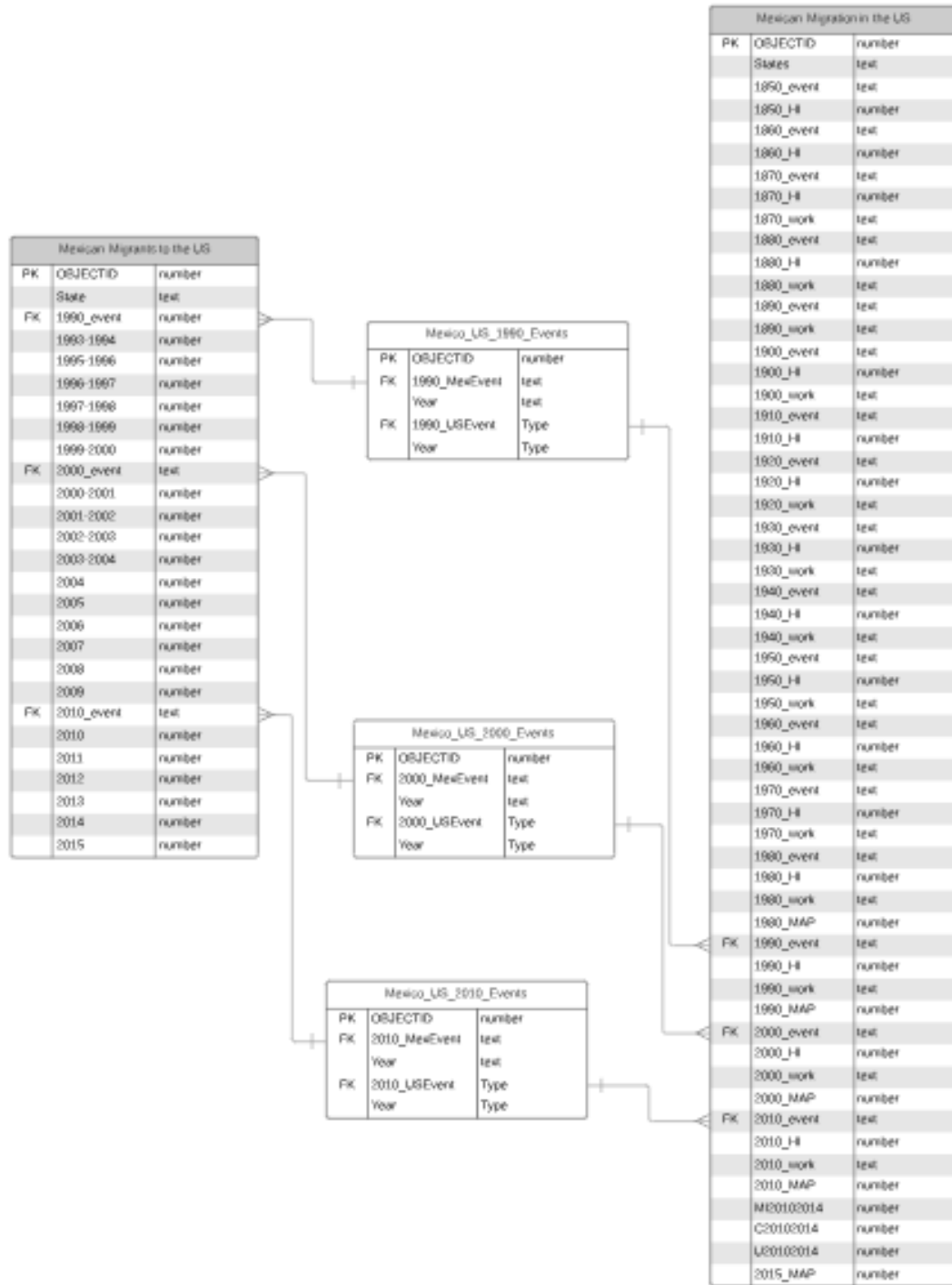


Figure 19. Planed future ER-diagram

If the HMMGD were to expand into an Entity relationship (ER) database, the relationships need to connect the main tables thought historical non-spatial data tables during a 3 decade periods of 1990, 2000 and 2010. These non-spatial databases could be created in ArcMap and tie the two tables together. Each decade table would be label as Mexico_US_”DECADE”_Events and would have the attribute field OBJECTID to associate the historical event with the “DECADE”USEvent and “DECADE”MexEvent” to both Mexico and US state ObjectIDs. The same method could be performed for previous decades thus calling for perhaps over 20 data tables as mention in Chapter 3.

Another data attribute to add would be the growing number of indigenous Mexican migrating into the United States and non-traditional homeland Mexican States. Reports from the former Comisión Nacional para el Desarrollo de los Pueblos Indígenas, or CDI now renamed Instituto Nacional de Pueblos Indígenas, INPI have been recording the movement and data of indigenous Mexicans since 1948. Reports have shown how certain indigenous Mexicans such as Nahuas have been migrated into new states such as Sinaloa from their former homeland state in Mexico, by examining these cultures it would be a better understand of what type of Mexican cultures are making the migration into the US and throughout Mexico. Perhaps this could help pinpoint and give access to services to monolingual Nahuatl, Mixtec and Zapotec speakers.

Additional data that could be added into the HMMGD may come from sources that have data base on income, industry, household size, education, economy trade, and from both Mexican and American tourism could be incorporated into this database. If this data would be added it would require multiple methods to cross reference these types of data to understand the thematically and semantics data. In return these data types should then be put into their own

tables and properly organized. This would ensure that the main table would not be overrun with too much attribute data.

One example could be to have an addition table that only focuses on the Mexican workers and companies that impacted the US agriculture industry. A primary key of that data table could then be connected with the “decade”_work table of the main US tables. A user could see data from the National Agricultural Workers, which would allow scholars to inquire as to the impact those workers have on the California-based industry. The same method could be used in other states as well. Other inquiries could include employment in construction, fast food, housing rent, utilities, local tax, and retail. If such a database were to add these datasets it may be reasonable to create a collaborative database like the HMMGD to allow scholars from different disciplines to have certain privileges to contribute to finding and adding this data to the database to help answer these questions.

To give permanent access to scholars, a future goal would be to transfer this database to a server or an online service. This would allow any scholar from around the world to input and analyze data from their area of interest with respect to Mexican migration. It would be essential to see if such a service could still provide the same features of ArcMap once migrated to such an online service. One of the main essential features would be to allow the features of uploading and downloading datasets from the HMMDG made available for scholars and researchers. This endowment shouldn't be too challenging as there should be multiple methods of uploading a database such as the HMMGD.

By creating the Historical Mexican Migration Geospatial database this allows and proves that users could ask multiple question about Mexican migration and even tie these questions with historical events or other datasets that have been converted into spatial data. By showing two

case studies this project meets its goal of showing the impact of Mexican migration in the US and Mexican and correlating it with historical events. These two case studies demonstrate the types of ways in which academics could explore this database.

Currently in the 21st century there has been multiple types of migrations that have hit multiple news outlets. There have been refugees from the middle east and Africa migrating into Europe, others from the countries of Central America have migrated into Mexico and the United States, the economy crash in Venezuela has push immigrants into other parts of the Americas. These same migrations could be further examine being using the same methods as the HMMGD. The HMMGD provides a means of exploring migration that is accessible to scholars from multiple disciplines. With the use of the HMMGD this provides a tool that use the multiple disciplines of anthropology, history, ethnic studies, global studies, economics. geography that can all work together supported by geographic information science to better understand one of the oldest and impactful human behavior that is migration.

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Esri_dm ESRI (2017) [Shapefile] us_generalized_states

Appendix

Feedback Results

User 1:

Profession: History Professor

After reviewing the database please answer the following question:

Do you think this type of database is a good idea?

Yes Its practicality and easy functionality make it a pioneering resource to explore the presence of migrant communities In the United States.

Do you find this database useful in your profession/area of study?

In one of my areas of Interest, the Mexican Migration Database can be a useful tool in exploring and mapping the flow of Mexicans across the border through the course of the twentieth century. A central question to my research on Immigration centers on location. Why do certain migrant communities move across the border to settle and establish other communities? While the database does not have a simple answer to the question of why, it does provide practical information that illustrates where Mexican migrants have established a foothold based on historical event and industries that may provide a solution that answer. A strongpoint in the Mexican Migration database is its customization.

Do you see yourself using this type of technology in the future?

the database provides Information for states in both Mexico and the United States, but future versions can include information for counties/municipalities. This ability could radically determine migrations shifts and its statistics used by government officials to target and provide services for these communities in both countries. This tool is a significant contribution to scholars that focus on not only Mexican migration, but also migration and borderlines studies as whole. I am glad that young professionals such as Jonathan are taking up the imperative task of providing innovative ways and tools for scholars such as myself to carry new lines of inquiry into such transcendental investigation.

User 2:

After reviewing the database please answer the following question:

Do you think this type of database is a good idea? Absolutely!

Do you find this database useful in your profession/area of study? Yes. In several areas of study, including Maiz/human migration in the W. Hemisphere or the Americas. And also, tracking law enforcement or official violence in the United States.

Do you see yourself using this type of technology in the future? Yes. Would love to for the several projects I am working on.

User 3:

Title: **Curator of Ethnohistory, Arizona State Museum, University of Arizona, with faculty affiliations with the Department of History and James E. Rogers College of Law.**

Thank you taking the time to explore this database. The intention in the development of this is to provide a resource for professionals and scholars working in this area.

How useful would you find this type of database in your profession/area of study?

I would find this type of database quite useful in my teaching and research. Students could develop research topics and write semester-long papers based on its contents. In my research, I would be able to track Mexican migration spatially and temporally.

What do you feel are the most positive aspects of the database as it currently exists?

The database's accessibility and searchability are its most positive attributes.

Based on your professional needs, how could the database be improved?

I would want to review the narrative before making any suggestions. As a historian, I would want to see how the database's creator contextualized the raw data embedded in the program.

How useful do you think this resource would be to other scholars/professionals within your field of study?

I see a variety of professionals, scholars, and entities that would be interested in the database, including historians who specialize in Mexican history and immigration history, but also NGO's, non-profits, policy institutes, and policy makers (for example, at the municipal, state, and federal levels). The database provides important raw data that can inform policy. I have a few suggestions in terms of the secondary literature; these books will help you flesh out historical context and also provide the human dimensions of migration.

User 4:

Profession:

Social Studies Educator (Retired)

After reviewing the database please answer the following question:

Do you think this type of database is a good idea?

Yes. This seems to be a valuable tool for geospatial analysis of statistical data. Any such innovation that is valid and reliable should contribute toward bringing figures to life for increased human understanding and utility.

Do you find this database useful in your profession/area of study?

For educators, the ability to present cultural trends visually is vital in conveying understanding of them. I can envision how a series of maps depicting changing patterns in Mexican migration (or similar cultural phenomenon) over time could be very useful in teaching about the topic. It would have value to educators not only in geography, but also in history, civics, economics, and sociology. Furthermore, the ability to generate an array of user-specified maps from the data could give students the rare opportunity to explore the topic and discover their own conclusions, thereby getting a feel for what academics in the respective fields actually do.

Do you see yourself using this type of technology in the future?

Yes, I can foresee use of this technology in the teaching profession. As a local political party chair, I can foresee myself and others (including politicians, journalists, and citizens on all sides of related political issues) benefiting from this tool for on-demand digestion of data for better practical understanding. As an amateur genealogist, I would be excited to see the extension of this same technology to the mapping of historical data on immigration from a wider variety of other source regions and subregions and even by specific surname in different eras (to the maximum extent that existing census and immigration data would support).

User 5:

Profession: Professor of Anthropology

After reviewing the database please answer the following question:

Do you think this type of database is a good idea? Yes, I think it is an excellent idea. Having this data collected and organized in an easily accessible manner through visual depictions is extremely valuable for both teaching and research.

Do you find this database useful in your profession/area of study? Yes. One focus of both my research and teaching is US-Mexican- Central American migration. This database is useful for correlation historical events to migration patterns. I would like to see this expanded to Central American countries as well. This work allows us to see the micro-events that drive at least some of the migration and connect them to larger processes.

Do you see yourself using this type of technology in the future? Yes, absolutely. Again it is an invaluable aid in both teaching and research.