2021

Mapping Ethnophysiographies: An Investigation of Toponyms and Land Cover of Missoula County, Montana

Emily L. Cahoon
University of Montana

MAPPING ETHNOPHYSIOGRAPHIES: AN INVESTIGATION OF TOPONYMS AND LAND COVER OF MISSOULA COUNTY, MONTANA

By
Emily L. Cahoon

Bachelor of Arts in English, University of Tennessee Chattanooga, Chattanooga TN, 2014

Bachelor of Science in Anthropology, University of Tennessee Chattanooga, Chattanooga TN, 2017

Thesis
presented in partial fulfilment of the requirements
for the degree of

Master of Arts
in Anthropology, General Option
University of Montana
Missoula, MT
May 2021

Committee Members:
Dr. Anna Prentiss, Chair
Department of Anthropology

Dr. Irene Appelbaum
Department of Anthropology
Linguistics Program

Dr. Cheyenne Laue
Department of Anthropology

Kevin McManigal M.S.
Department of Geography

Abstract

This thesis investigates the ethnophysiography of Missoula County, Montana via place names. Toponyms and landscape have been observed to have a relationship that can be studied through many lenses. Ethnophysiography, the study of how language and landscape relate to each other via human conceptualization, is a lens that was applied to this thesis because it recognizes the embodied information that toponyms carry and investigates landscape accordingly. Thus, the following research seeks to understand if ethnophysiographic diversity exists between toponyms in the Salish and English languages of Missoula County, Montana by analyzing place names and land cover in GIS and analyzing the data for a Zipfian distribution. I research, collect, and analyze the secondary information available on Missoula County names and land covers in order to empirically examine this ethnophysiographic relationship.

Acknowledgments

The opportunity to become a graduate candidate and earn my Master of Arts from the University of Montana could not have come at a more significant time in all our lives. Having been a dream of mine for some time, I would not have gotten far without the people in my life who helped me to build this research, guide me through mental and academic obstacles, and supported me during those times of low hopes with hugs from afar.

Thank you to my fellow graduate students for all the post-theory happy hour shindigs before the pandemic was even a thought. Thank you to working out problems in GIS with me. I'll never forget the joys of learning new tricks from fellow cartographers and archaeologists. Thank you for sharing your knowledge of the heritage, culture, and language of Montana and for talking with me about my project. The beauty of this land and people runs deep in time and it has been a privilege to study alongside you.

Thank you to my roommates who coped with me through some crazy ups and downs along the way, listened to me read and reread pieces of my thesis out loud, and for the late nights spent finding the best words on many thesaurus websites. Thank you to my friends and family who listened to my struggles, shared your experience and advice, and celebrated with me at every accomplishment along the away. Your support has kept me strong. Thank you to my Map Missoula people whose genuine excitedness and endearment for my research has kept me excited too. Thank you to my professors who always made time to discuss my research and offer advice for researching a topic so new and cross-disciplinary.

And lastly, thank you to my committee members. Kevin, thank you for all the knowledge you've taught me during my time at UMT and problem-solving methods in GIS. I always look forward to catching up and nerding out about cartography, space, and so much more. As it was my primary goal to use GIS in my thesis from the beginning, you have offered your guidance through this entire process, and I will always and forever judge a map by its projection now.

Cheyenne, the skills you've taught me and the support you've given me have been invaluable. Thank you for sharing your classroom and allowing me to experience being on the other side of the desk. Thank you for all the late night and early morning Zoom calls and advise when I just didn't know what to do and thank you for keeping me on my toes and out of my comfort zone… by which I mean math.

Irene, thank you for all the coffee meetings to discuss linguistics, philosophy, and of course, my thesis. Learning from you has been amazing and it has been wonderful to have you as a committee member for my thesis. You keep my thoughts on track on paper and force me to explain what I mean. I look forward to our next visit to Café Dolce for coffee and great conversation.

Thank you, Anna for taking me on as a graduate student and filling the role as Committee Chair. Working with you and learning from you has been exciting and fulfilling. You offered me peace in times where I underestimated thesis tasks and confidence in my abilities as a graduate

candidate that made the success of this thesis possible. Learning from you during my time here at UMT has been rewarding in more ways than one.

Table of Contents

Figures and Tables

Figures

<u>Tables</u>

Chapter One: Missoula County and an Ethnophysiographic Study

"Once, from eastern ocean to western ocean, the land stretched away without names. Nameless headlands split the surface; nameless lakes reflected nameless mountains; and nameless rivers flowed through nameless valleys into nameless bays. Men came at last, tribe following tribe, speaking different languages and thinking different thoughts. According to their ways of speech and thought they gave names, and in their generations laid their bones by the streams and hills they had named."

--Stewart 1945:3

Introduction

Robert McDonald, spokesperson for the Confederated Salish and Kootenai Tribes (CSKT), once said, "'names are critically important'" (Miller 2021:3). Embedded in the cultural geography of a landscape, is knowledge of how humans and the land establish and strengthen these relationships to place, heritage, and life. In Western Montana, place names, as with many names in the present United States, feature Indigenous and Historical significance and origin. A deep connection between these names and the landscape enriches the multiple scales of culture that belong to so many who have and do occupy these mountainous environments.

Séliš, for instance, is the unanglicized version of *Salish*- the English name for the Flathead/Bitterroot/Interior Salish Peoples of the Pacific Northwest. As explained by Bear Don't Walk (2019), however, the Salish Peoples refer to themselves as *Sq̓elixʷ*, which in English translates to, *flesh (or meat) of the land* (Salish-Pend d'Oreille Cultural Committee 2018[2005]). It is these first North American cultures, along with other neighboring Tribes, for which the first names were set upon the land and carried through the eras since Time Immemorial. Historically, as non-Indigenous Peoples moved into the region to settle the land with different cultural representations, place names began to change, though some names belonging to or associated with the first names from Indigenous languages have been retained through the years and generations of European naming practices. This can be seen in names that reflect English or other European translation of the original term, anglicization[1] of words, and naming reclamation practices. An example of this is observed with Woodchuck Creek near the Southern border of Missoula County where the name references the collection of ground hogs for roasting by the Salish and Pend d'Oreille Tribes. This area's original Indigenous name is *Ep Smc̓ec̓- It Has Ground Hog* (Malouf 1952 and Salish-Pend d'Oreille Cultural Committee 2005[2018]).

The following thesis presents an anthropological, toponymic landscape study focusing on an ethnophysiographic model. The goals of this research are to examine toponyms (place names) of the Missoula County area and the relationship these names have with place. Ethnophysiography is a relatively new form of study introduced in 2002 by David Mark and Andrew Turk with further contributions by David Stea in 2004 (Turk and Stea 2014). This transdisciplinary field studies the relationship between language and landscape. This means the connection between language and the natural environment is investigated through a number of diverse academic and collaborative lenses. Ethnophysiography follows a ground up theoretical model of development and implementation by drawing from existing case studies in varying disciplines (Mark et al. 2011 and Mark and Turk 2003). With regards to this model, studies from anthropology, linguistics, geography, ethnography, and more are utilized to understand the conceptualizations humans have to places or environments according to specific language or linguistic attributes.

Landscape vs. Land Cover vs. Land Use

[1] Anglicization: linguistically modified to the underpinnings of the English language (McArthur et al. 2018).

It is important to clarify some terms which can carry diverse connotations across disciplines. These terms are *landscape, land cover*, and *land use.* Beginning with *landscape*, three distinct meanings (semantics) are associated with this term (Rouse 2018): (i) referring to a style of art which depicts natural environmental elements or scenes (Clarke 2010), (ii) physical and natural environmental features which produce a visual area of place (Mayhew 2015), and (iii) cultural embodied meaning or social significance of terrains and places (Rogers et al. 2013). As this thesis is concerned with the connection humans build with landscape through language, the second and third meanings for *landscape* are used interchangeably throughout this report. *Land cover* and *land use* differ in that *land cover* specifically refers to the biophysical features which 'cover' the surface of the Earth and are thus classified according to its associated cover whether that be forested, urbanized, glacial, or other terrain types (Mayhew 2015). By contrast, *land use* directly refers to descriptive contexts or where and how the land, place, or space is 'used' (i.e. agriculture, environmental management, residential, etc…) (Manley et al. 2019).

This thesis examines toponym descriptions via an ethnophysiographic perspective. This means this research studies the relationship that place names and their definitions have with the landscape according to associated land use and cover as described by the existing body of literature on Missoula County. By utilizing a phenomenological theoretical approach to frame the analysis, the following project applies the ethnophysiographic model by collecting information on place names and land cover of Missoula County, Montana. This opens an investigation to understand how the landscape is connected to its place name according to changing cultural land use periods of the spatial region in question due to colonialism/westernization. Western Montana is a good study area for this type of inquiry due to its profound repository of cultural, linguistic, and geographical heritages.

Inspiration and Sense of Place

The inspiration for conducting an ethnophysiographic case study of Missoula County was initially by the desire to bring the social and physical sciences together through the use of Geographic Information Systems. In anthropology, theory often can be assumed to lack sufficient merit for physical scientific inquest since the body of data and evidence surrounding the study is primarily qualitative. However, a transition from theoretical perspectives to empirical approaches can be seen in the more recent decades, bringing the physical sciences and the social sciences to equal grounds with the use of spatial, cognitive, and other technology. Examples of such transdisciplinary research can be seen in works by Laughlin and Rock (2013), Lackoff and Johnson (1999), Majid et al. (2004), Lengen and Kistemann (2012), Burenhult and Levinson (2008), Zhang (2014), Kuhn (2002aandb), Wolf (2008), and more. Popular themes in social research are transitioning social data to quantitative measurable results. This cross-disciplinary and transitional mode of research is becoming increasingly vital to understanding human behavior, geography, and environment on a number of scales that can benefit other disciplines and communities both in and outside of the academic realm. Collaborative means between academia and communities whose language, landscape, and heritage are significant to truly understanding and measuring ethnophysiography, can be seen in case studies regarding the Yindjidarndi, Navajo, Ahtna Athabascan, Hawaiian, and more (Mark et al. 2011; Kari 2011; Louis 2011).

It is asserted by Relph (1976) that place does not exclusively denote a geographical region, but rather is a compilation of location and all the associated habitual and terrain features as they embed meaningful experience (1976:3). This concept is known as 'sense of place' and was used by Relph (1976), Tuan (1977), and others by the end of the 20th century. This concept more directly defines emotional attachments to place by embedding meaning full information involving cultural underpinnings (Lengen and Kistemann 2012). Sauer (1939) claims that a landscape is an expressed interaction by humans with their environment. This can be observed through several lenses including archaeological (Tilley 1994 and Brück 2005), anthropological (Hirsch and O'Hanlon 1995; Desjarlais and Throop 2001; and Friedland 2009), linguistic (Cablitz 2008 and Cogos et al. 2017), and neuroscientific (Lengen and Kistemann 2012 and Louwerse and Benesh 2012).

Employing a Phenomenological Paradigm

Phenomenology is a theoretical paradigm, which is known as the study of phenomena (Smith 2003 and Darvill 2009). This discipline observes conscious phenomena or experience of a subject via their first-person perspective in order to more closely understand the experience associated with facets of human life. Philosopher Edmund Husserl is considered the 'Father of Phenomenology' (Gallagher 2012) and he established the School of Phenomenology at the beginning of the 20th century. This led to contributions by Heidegger who developed the practice of fundamental ontology and studied the existence of *being* (Heidegger 1962); Merleau-Ponty, who investigated human perceptions and meanings therein (Merleau-Ponty 2012[1962]); and Sartre who adopted phenomenology to lay the groundwork for the concept of *otherness* in ontological thought (Smith 2003, Toadvine 2016, Wheeler 2011). Since its inception as a theoretical perspective, academics have utilized this theoretical framework and the embodied underpinnings (a sub-theoretical perspective of phenomenology) to ground social and physical scientific research. Some examples of this can be seen in phenomenological investigations of archaeology through material remains by Barrett and Ko (2009) and Tilley (1994), anthropological investigations of sacrifice and ritual by Throop (2015) and Ram and Houston (2015), medicinal and body ailments by Csordas (2015) and cross-cultural experiences via cognitive activity by Laughlin and Rock (2013).

As stated by Csordas (1990), the embodiment paradigm emphasizes the reinvestigation of existing data. This is done in an effort to extract empirical research questions via a methodological study of culture on a community and independent scale where the human body is the subject of culture rather than the object of culture being studied. Likewise, it is suggested that, in English, words have the power to convert objects into place (Bruenhult and Levinson 2008:137). As it is understood by Basso (1996), Fagúndez and Izco (2016), Pippitone (2019), Leonard (2021), and Louise (2011), place names encode and embody phenomena, and is why a phenomenological framework is applied to this thesis because the social, cultural, and linguistic integrity is held when analyzing data empirically via power law statistics and geospatial investigation.

Spatial Area and Population Demographics

Covering an area of 2,618 square miles, the present-day boundaries of Missoula County (Figure 1) are located in Western Montana, in the Northwestern region of the United States. Often referred to as the center of the five valleys, the county is home to parts of the Bitterroot, Sapphire, Granite, Mission, and Coeurd d'Alene Mountain Ranges where approximately 119,600 occupants reside (USCB 2019). As of 2019, 60% of Missoula County lands are managed by governmental entities (not including an estimated 5.8% of this being Tribal lands). Roughly 35% of Missoula County land is privately owned- most of which occupies lower elevation areas within the valleys while nearly 39% (or 59,175 acres) of county land is reserved for open resource and recreation public land access (Missoula County 2019). With efforts by the Montana

Legacy project, which focuses on the conservation of woodland biomes and public lands in Western Montana, an estimated 159,732 acres were transferred from private to public land ownership over the course of seven years. This is significant for wildlife and vegetation conservation management and preservation. Likewise, the project offers insight to biological and environmental information for cultural heritage studies such as Traditional Ecological Knowledge (TEK), which has been a concentration in geographic and Native American studies of this area over the last few years (Bobbitt 2015 and Bear Don't Walk 2019). As of 2018, the ethnic distribution of Missoula County is predominantly populated by residences who identify as White (Non-Hispanic) at 89.4% of the population total. The second and third largest populations are those who identify as Native American (2.22%) and non-Hispanic multi-racial (2.95%) (USA Data 2019).

Missoula County was specifically chosen for this study, because, historically, the county is one of the original 7 county regions of the Washington, Idaho, and Montana territories (see Figure 2) and has changed significantly with Montana's transition into separate territory and later statehood in 1889 (Bancroft 1890). The present-day shape of the county is relatively young- established in 1923- and with respect to official planning and zoning regulations the shape is still subject to adjustments in the future. The evolution of the Missoula County shape can be seen in the following map (Figure 3). The current shape of the county was formed when neighboring counties were created from its domain after Montana officially became a

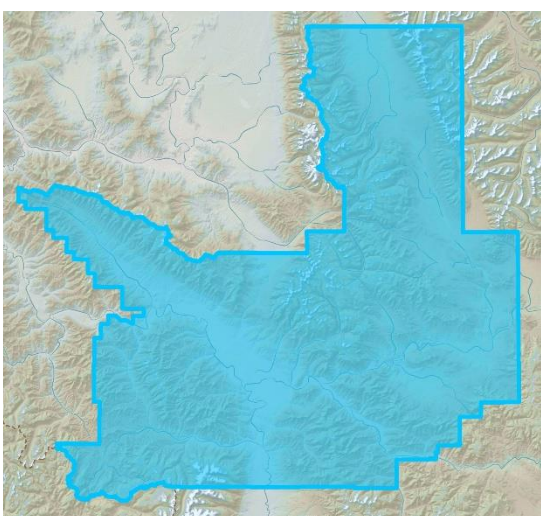

Figure 1: Modern shape of Missoula County, Montana. Projected in the MT State Plane (ft) with a central Meridian of (-114) for Missoula. Orientation- north.

state. The counties created from the early Missoula County regions are the Flathead and Ravalli Counties (1893), Sanders County (1906), Mineral County (1914), and Lake County (1923).

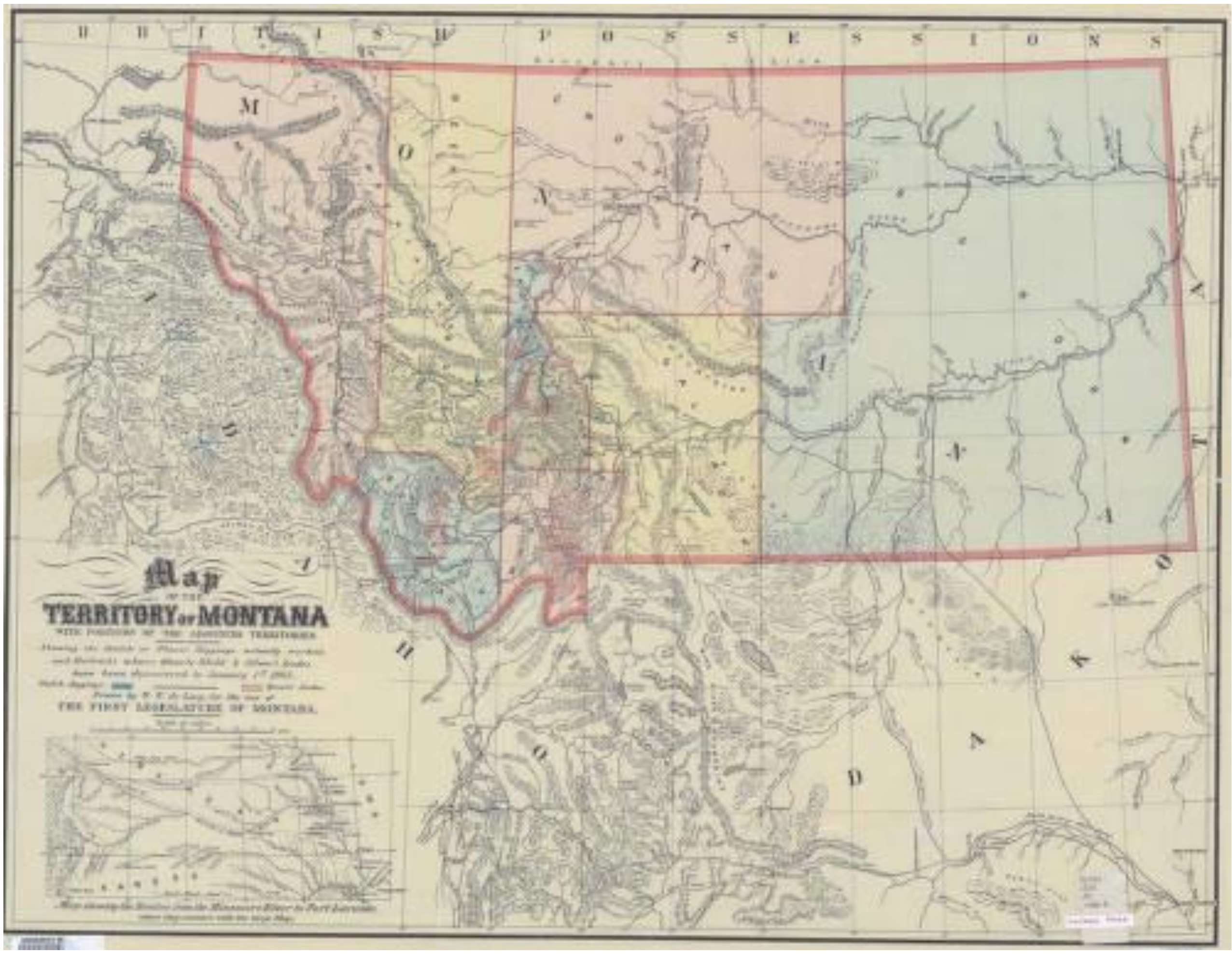

Figure 2: Territories of Montana map from the State Historic Preservation Office- Montana Memory Collection (1855) Link.

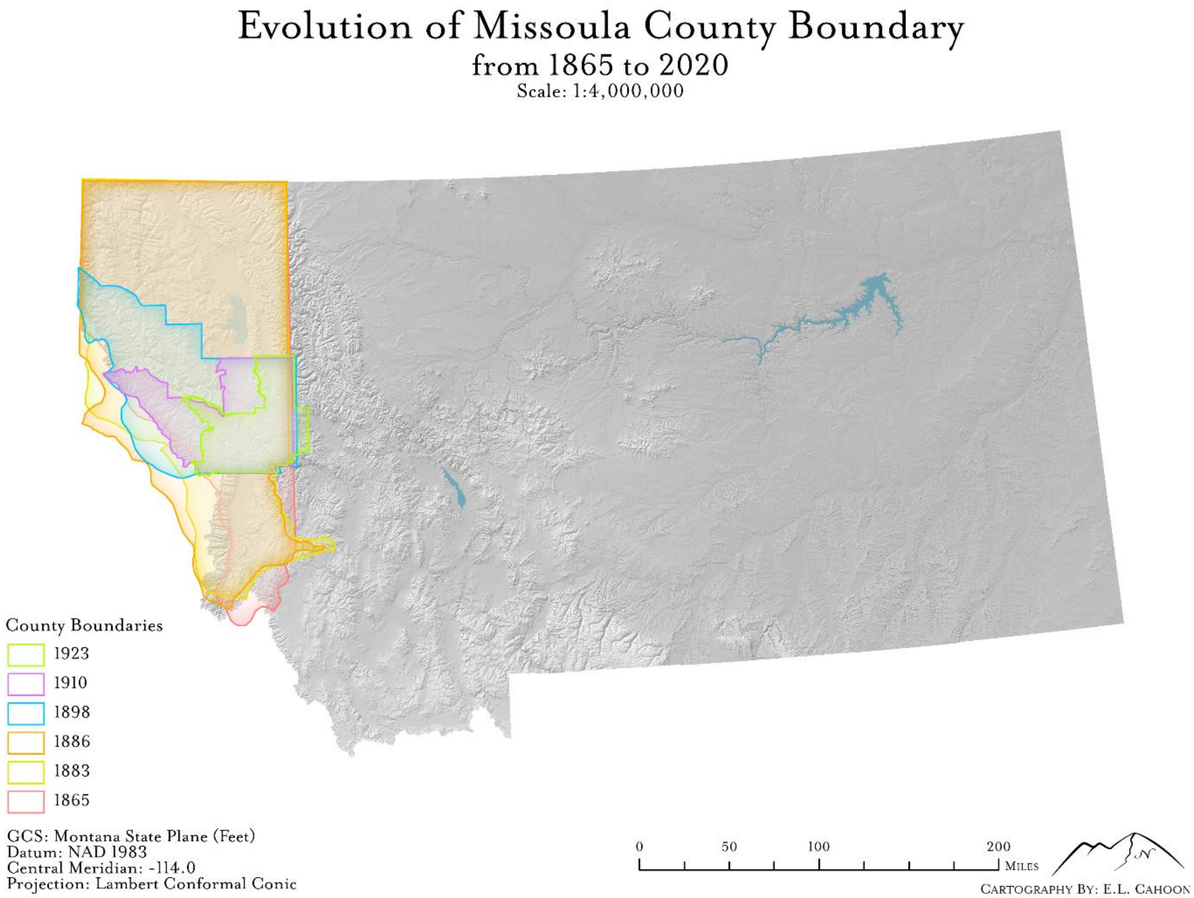

Figure 3: Evolution of Missoula County Boundaries from 1865 to 2020- a reference map created for this thesis by the researcher to show the transition of the county shape. The information to make this map was collected from the Mont. GIS Clearinghouse online database and georeferencing maps from the State Historic Preservation Office (SHPO) archives.

A strong regional focus will be applied to the county and its valleys for analysis, however, the data analyzed does extend beyond the boundaries of the present county for three reasons. As stated previously, (i) county boundaries are subject to change due to state, local, or other regulations and circumstances. Within the last five years alone, for example, county commissioners have discussed the possibility of adjusting some boundary lines between Lake and Missoula County. The County shapefile illustrated in Figure 1 is the most recent layer available from the Montana GIS Clearinghouse and has not officially changed since 2019. (ii) As some of the data for this research pertains to areas referring to historic or past boundaries of the county, Missoula and its surrounding areas are referenced for the scope of this study. In addition to studying Euro-American toponyms, this thesis explores traditional Native American toponyms and their description that define the place name and why a site was named, which is important to understanding its connection to the land as well as modeling early land covers and land uses. These Indigenous names do not follow county guidelines and also extend outside of the present-day borders of Missoula County. However, (iii) applying boundaries to place is not always appropriate or the information to do so is not always available (Bruenhult and Leveinson 2008 and Mark and Turk 2003). This is why the Missoula County boundary is used as a point of reference for the bulk of the data being investigated and analyzed and as such will be used as the general term to describe the area of interest.

History and Prehistory of Missoula, Montana

Missoula and its surrounding valleys were once a large glacial lake. Modern geologists have named this lake Glacial Lake Missoula (seen in Figure 4), and the scars of its past existence can still be seen from the viewshed of downtown Missoula (see Figure 5). From studying the sedimentary deposits and the striation on the slopes of the valley mountains suggests that the summits of Mount Jumbo would have been small islands in this lake, much like the following illustration in Figure 6. The lake stretched over many acres of terrain and- for the time of ancient Missoula- this site is known as *Nmesúletkʷ*- or *Place of Freezing Water* to the Salish (Personal Communication 2019), from which 'Missoula' is derived. From these geologic features, geologists confirmed two distinct Ice Age periods. From the British Columbian glaciers in Canada, waters filled the valleys of the Northern Rocky Mountains in what is now known as Northwestern Montana. The rising and sinking levels of the lake are estimated to be around

15,000 years old- roughly following the periods of the last Ice Age. During its life, the depths of Glacial Lake Missoula averaged at least some 2,000 feet near the ice dams which helped form the lake. From this knowledge, it would resemble a similar volume to present day Lake Ontario for scale. Sedimentary deposits recorded in Western Montana provide evidence for at least 36 fillings and/or refilling of the lake, which suggests that the lake had been drained roughly 41 times before its final drainage nearly 13,000 years ago. The last re-filling of the lake lasted nine years compared to its initial filling, which remained for roughly 58 years. (Alt and Hyndman 1986; Alt 2001; and Salish-Pend d'Oreille Cultural Committee 2005[2018]).

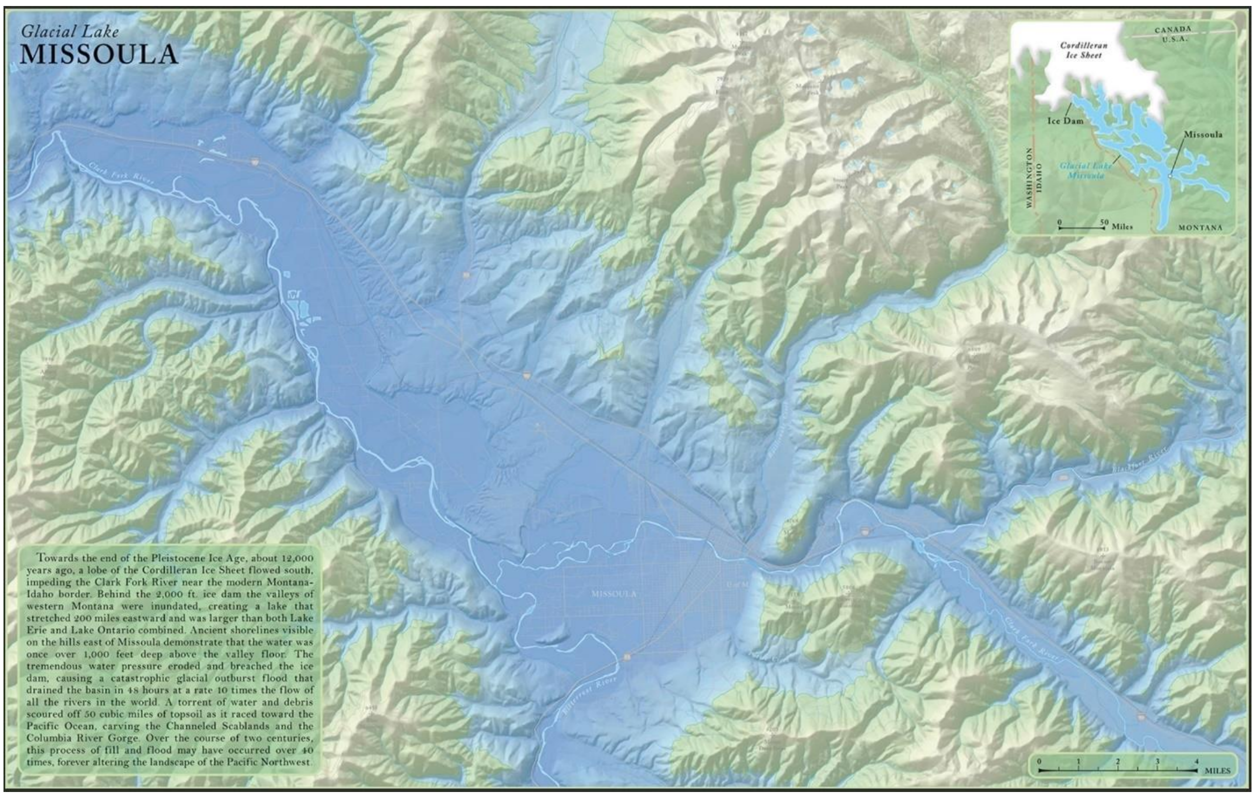

Figure 4: Cartographic rendition of Glacial Lake Missoula in an aerial, planner view by Kevin McManigal, Orange Peel Cartography (2009).

Figure 5: High oblique aerial image of Mount Jumbo showing the lines of striation on its slope. Image downloaded from Google Earth.

Figure 6: Artistic rendition of a low oblique viewshed of Hellgate Canyon from Southwest Missoula during the time of Glacial Lake Missoula. Mount Jumbo is represented as an island. This image was created using graphic overlays of an imaged downloaded from Google Earth for the purposes of this thesis by the researcher.

Modern humans migrated to the North American continent from Asia over 15,000 years ago (Montaigne 2020). The hypotheses surrounding how and why these migrations took place has been one of the most popular and debated theories in anthropology (Borden 1979 and Davis 2019). While it is proposed that different subfields of archaeology may offer material evidence to these questions, geology remains to be one of the largest hurdles to archaeologists in investigating these migrations due to the rising and falling of oceanic waters during the Ice Age periods. As the human species is understood to have originated in Africa- due to material remains of early modern human ancestors- some 200,000 years ago, it is suggested that migrations out of Africa began roughly 130,000 years ago. These groups who ventured to North America around 15,000 B.P. are often referred to as the First Peoples, whose arrival is suggested to be possible via the Bering Strait land bridge, which connected the Asian and North American continents at present day Siberia and Alaska (Young 2018). These First Peoples became the various tribes and nations of Native North America (Young 2018 and Davis 2019). Though archaeological and cultural knowledge suggests that humans populated these areas at the time of the glacial lakes, it was at this time of the last drainage that the First Peoples migrated to the lower contours of Missoula and its surroundings valleys with significant cultural diversity across North America by the end of Wisconsin's glacial era (Sauer 1963 and Davis 2019).

The Salish and Pend d'Oreille Native American Tribes

While the Treaty of 1855 established the Flathead Indian Reservation, the Salish, Pend d'Oreille, and Kootenai Tribes occupied all of present-day Western Montana and other parts of Wyoming, Idaho, and Canada (CSKT 2021) prior to colonialism. The subsistence patterns of the Tribal Peoples have built a knowledge about the environment which is embodied to seasonality and place and is preserved and passed down through "oral history and a spiritual tradition" (CSKT 2021:1). The experience of the Western Montana landscapes has been utilized by Tribes since roughly 13,000 BP (see Figure 7) where Indigenous societies bonded with these mountainous environments through practices of traditional medicine, a wealth of flora and fauna, and spiritual foundations (Aleto 2001). It is said that language is a vital source of information that offers an understanding as to how the world is perceived to Indigenous communities (Bear Don't Walk 2019:11). Examples of this can be seen in place names, plant names, and cultural traditional stories and life ways. While the Kootenai language is considered a linguistic isolate, the Salish and Pend d'Oreille speak a branch of Salish known as Interior Salish. Interior Salish is part of the Salishan language family, which spans from Western Montana to the Pacific Northwestern Coast lines of Washington State and British Columbia as seen in Figure 8.

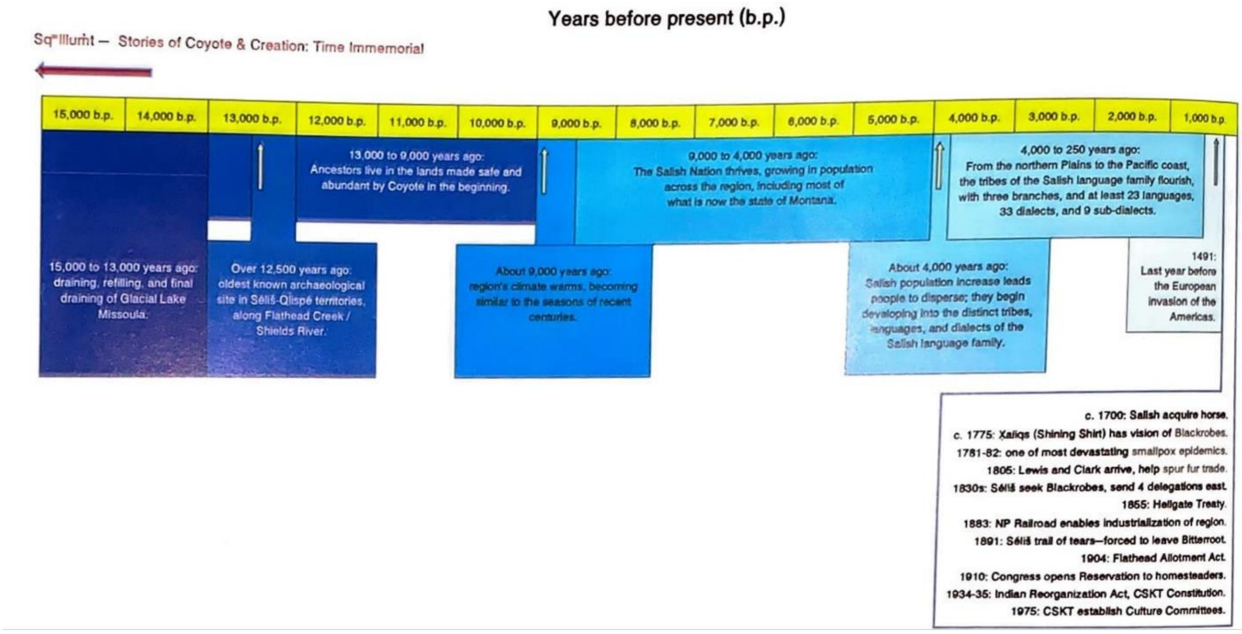

Figure 7: A timeline of Missoula according to the Salish Coyote and Creation stories (Salish-Pend d'Oreille Cultural Committee 2005[2018]).

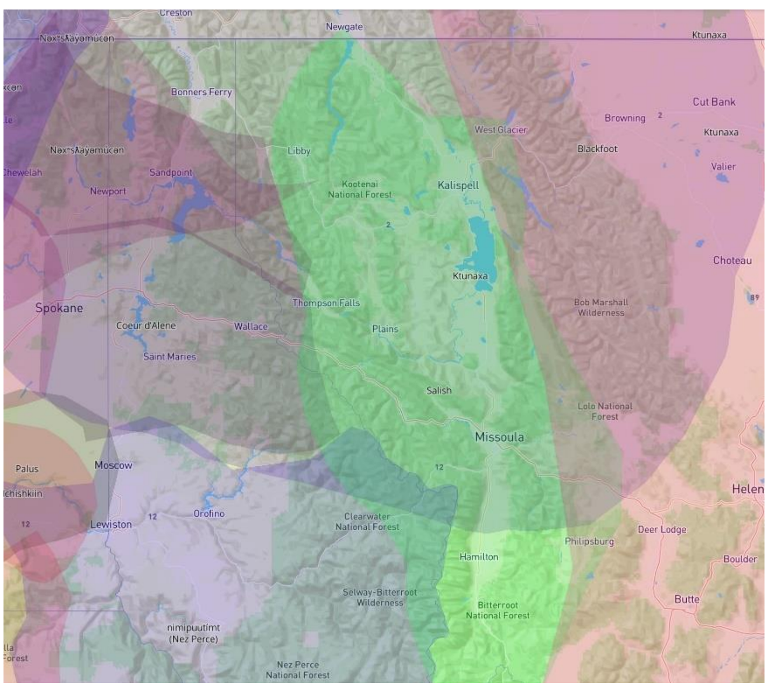

Figure 8: Interior Salish language region in Western Montana. Map exported from (https://native-land.ca/)- an interactive online platform of Indigenous languages, Tribes, and treaties.

Figure 9a: An early map of Indigenous language families North of the Mexican-US boarder by John Wesley Powell in 1903. Downloaded from the Montana Memory Project- Mapping Montana and the West collection.

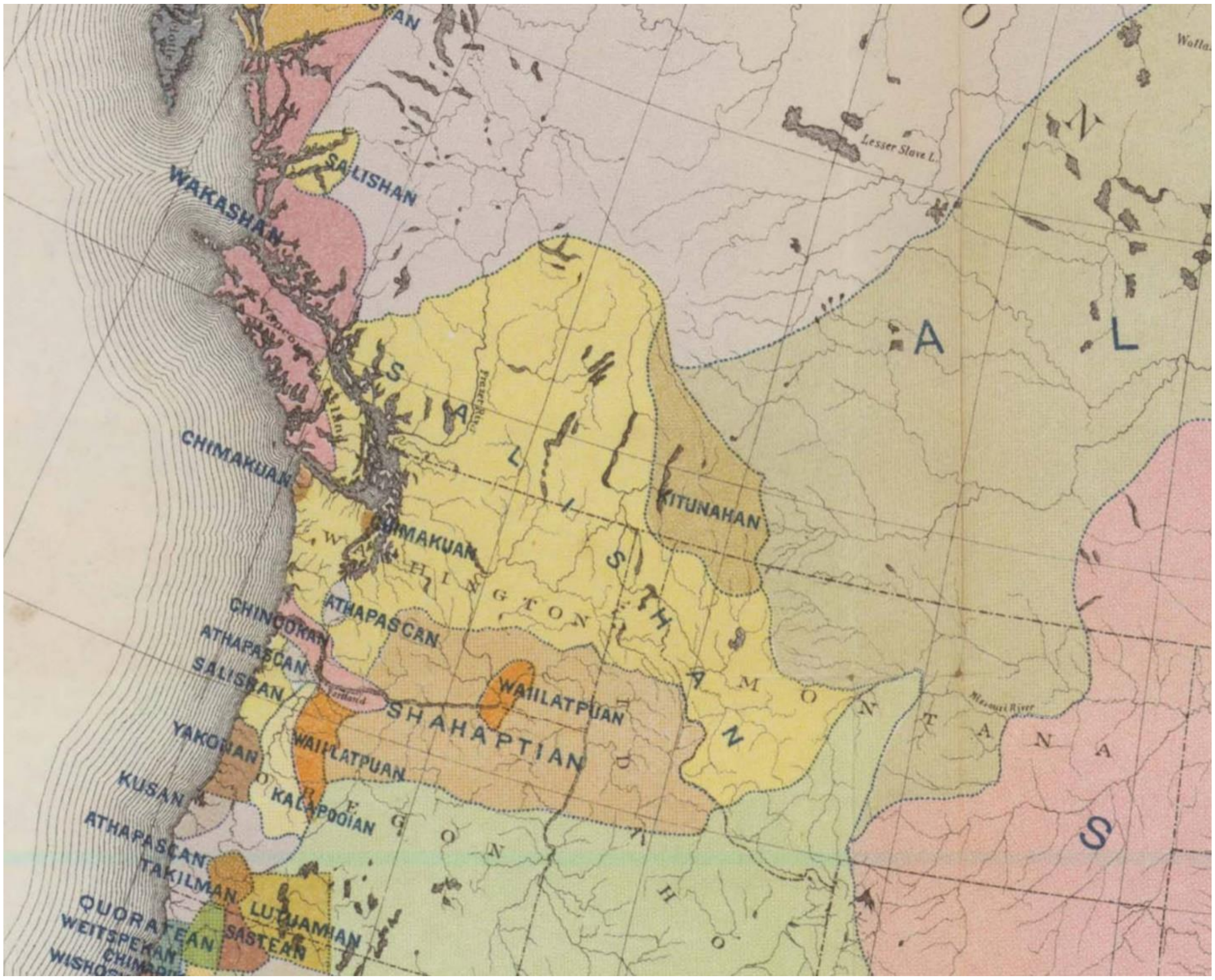

Figure9b: A cropped/close-up view of Figure 8a showing the Pacific Northwestern region of the United States.

Before colonialism, temporality was regarded by the First Peoples on a seasonal scale which follows events of a life cycle of plants and animals (Dixon 2014:182 and Bear Don’t Walk 2019). This pattern of seasonality can be seen in land use traditions by the Salish and Pend d’Oreille Tribes during traditional seasonal hunting and gathering practices. The places in which diverse species of flora and fauna were hunted and gathered, camps were established, and traditional landscapes were used is often denoted according to the location’s place name (Turner 2014 and Bear Don’t Walk 2019). Such examples of this can be observed in areas such as present-day Council Grove and Lolo Pass (see Figures 10-11). Several of these claims of how the land was used offer material evidence through the archaeological record. Many sites used for camping while moving across the Western Montana terrain offer structural remains proving their site use. Likewise, remnants of the trail used by both the Nez Perce and the Salish Tribes can be seen in modern wilderness, which is in the process of being preserved at the efforts of the US Agricultural Committee and Indigenous collaboration. This trail is recorded on the United States Geological Survey (USGS) as the Lolo Trail (Historic).

Figure 10: Council Grove State Park, Montana. Popularly known as the site for which the Hellgate Treaty of 1855 was signed, permanently moving the Native American communities from the Bitterroot Valley to the present-day Flathead Indian Reservation.

Figure 11: Lolo Pass visitor's center at Lolo Pass, Montana-Idaho Boarder.

Collecting information from historic maps from the Montana State Preservation Archives, the Montana Memory Project, the University of Montana Special Collection Archives, and various ethnographic reports and published journal entries, a collective map of Tribal domain transition to federal Tribal reservations can be seen over the course of 400 years in Figure 12. The data have been simplified to match standard cartographic practice for general interpretations. This means that out of the total amount of information and maps collected to create this map, only five final layers of boundaries have been used to display this information. That being said, much of the literature refers to cartographies that were hand created or modeled by Indigenous cartographers, the Confederated Salish Kootenai Tribes (CSKT), or maps from the Montana Memory Project and/or State Historic Preservation Office (SHPO).

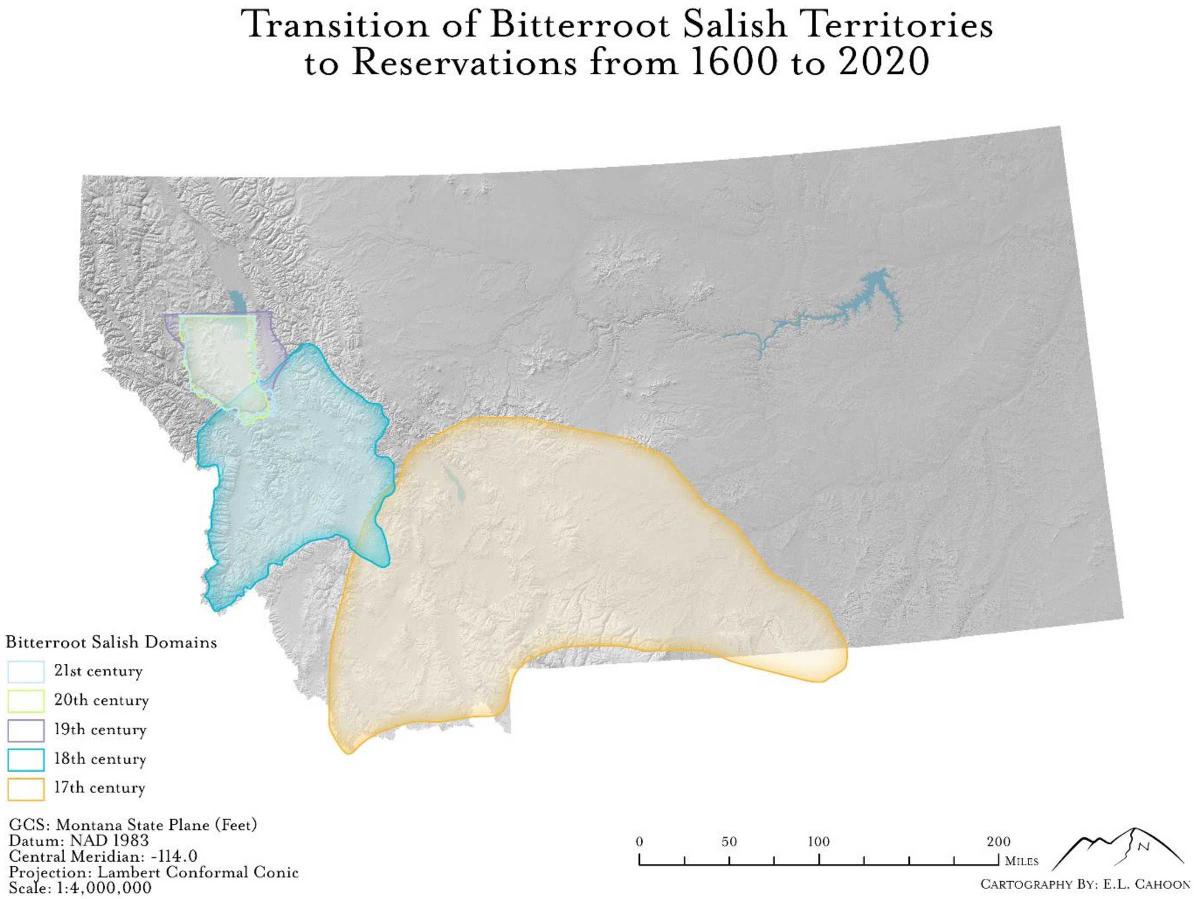

Figure 12: A reference map showing the changes in traditional Salish domains to the modern Flathead Indian Reservation. The information used to make this map includes hand drawn maps from ethnographic economic reports, georeferencing maps from SHPO, and from the Mont. GIS Clearinghouse.

Research Parameters

As the goals of this research are to investigate a relationship between Missoula County place names and spatial landscapes associated with those names to extract a conceptualization of landscape experiences; ethnophysiography is the main lens utilized for this thesis. This means that toponyms in diverse languages are inquired after. The predominant Native American cultures who originally named the Western Montana landscapes include Salish, Pend d'Oreille and Kootenai along with other Tribes who share the present-day state boundaries such as the Nez

Perce to the west and Black Foot to the Northeast. Since this thesis relies on extracting ethnophysiographic information from secondary source material and to meet the time constraints of a master's research project, two toponym languages make up the place name datasets for analysis and investigation- Interior Salish and Euro-American English.

Language is complex and the Salishan language family is comprised of 23 languages. Of these languages, the Salish-Pend d'Oreille of Western Montana speak Interior Salish. While some places may share names by different Native American languages (i.e. *k̓ uysey ̓ne ̓iskit- Road to the Buffalo (Nez Perce)* and *Naptnišá- Trail to the Nez Perce (Salish)* which refer to the present-day Lolo Trail (Historic)), Interior Salish place names and English place names are the two languages used for this research because of the body of existing information and case studies available for the Missoula County region. Although the secondary information regarding the descriptions behind these names and translations is not primarily collected, ethnographies from Malouf (1952), Bear Don't Walk (2019), Indigenous heritage publications by Salish-Pend d'Oreille Cultural Committee (2005[2018]) and Plateau People's Web Portal, and state and local archival records from the Montana Memory Project and the University of Montana special collections archives, have made this investigation possible. That being said, these goals aim to conduct a scientific investigation wherein the relationships between place names and places are studied in unbiased practices and seeks to objectively learn about these connections through quantifiable methodologies with a supportive body of linguistic and anthropological evidence.

By following Omundson (1961) methods for conducting a toponymic lexicon of Missoula County place names to manage and simplify the data, non-urbanized toponyms were collected as data or used for this research analysis. This is because urban place names can consist of street names, plazas, towns, and cities that require focused collection, organization, and measurement that does not fit the temporal parameters of a master's level research analysis. Though urbanized sites are mentioned and at times do appear in the database, they are not specifically studied with regards to ethnophysiography. These urbanized sites are included for consistencies throughout the data or if their descriptions are relative with settling a current metropolitan area. Two examples of this in the research are present-day Missoula and Lolo.

Furthermore, the datasets of toponymic information consist of one point layer in the Interior Salish language and one point layer in the English language. These two languages were used for this thesis for three reasons. Firstly, while the three prominent Tribal domains of Western Montana are the Salish-Pend d'Oreille, and Kootenai communities, Missoula County primarily resides inside the previous territories of the Salish-Pend d'Oreille Tribes, who speak related dialects of an Interior Salish language (Malouf 1952 and Eberhard et al. 2021). These domains, which were hand drawn for an ethnoeconomic report by Malouf (1952 and 1962) can be seen in Figures 13-14. Secondly, in the United States, names are often altered or changed to better suit the English language. Anglicizing these names became official with the transition of naming authorities to a state and/or national board of geographic names (Stewart 1945 and Monmonier 2006). Lastly, there is a large repository of Salish and rural English toponyms available for creating a geo-dataset for Missoula County. These databases include ethnographic reports, cultural and digital heritage projects, and lexical investigations of the county and its bordering regions.

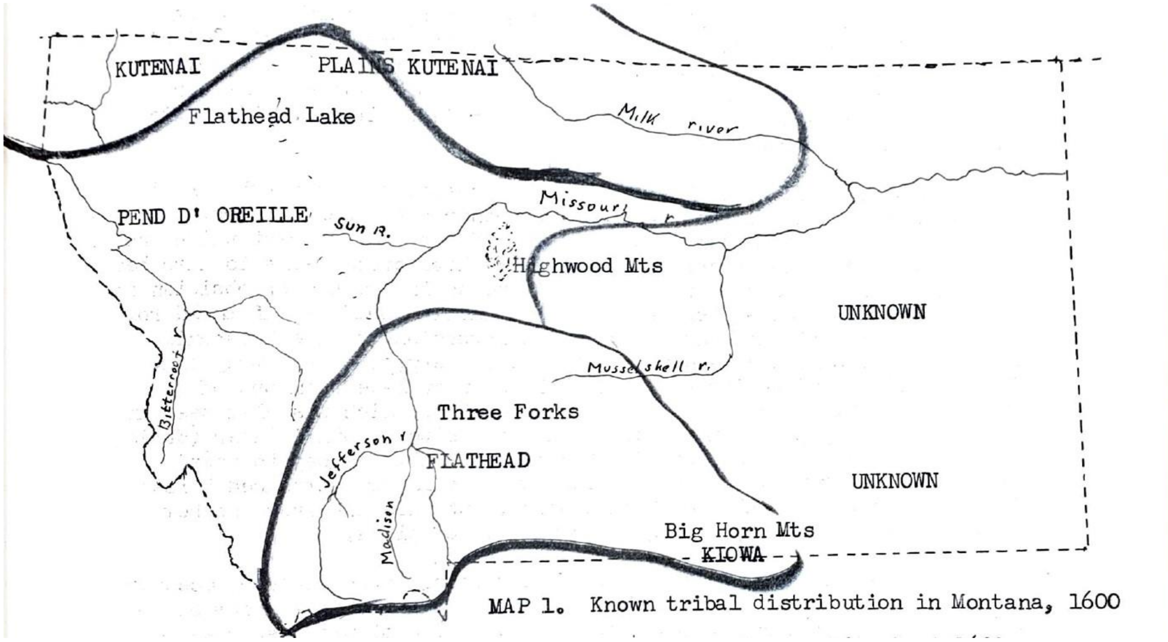

Figure 13: Hand drawn map of the Salish (Flathead), Pend d'Oreille, and Kootenai Tribal territories circa 1600 published in *Archaeology in Montana* (Malouf 1962:5)

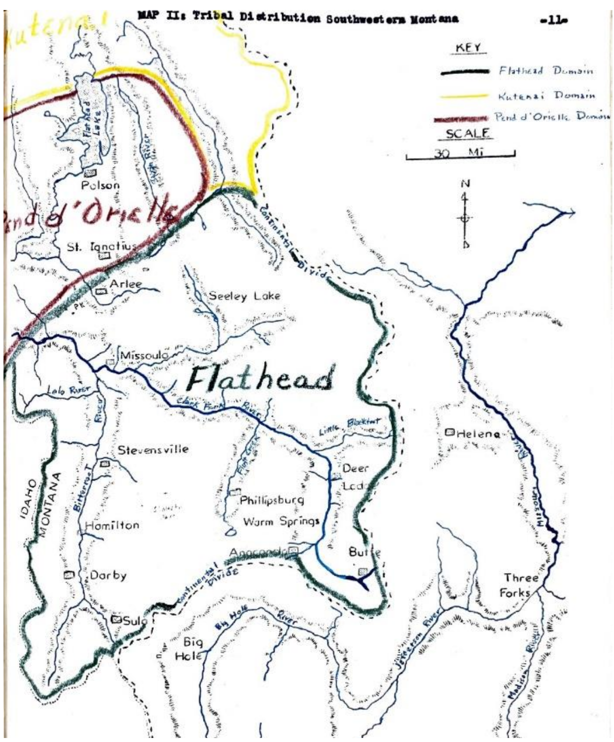

Figure 14: Hand drawn map of the Salish, Pend d'Oreille, and Kootenai Tribal territories during the 1700s to 1800s via ethnographic interviews for an economic report on Western Montana (Malouf 1952).

It is not in the nature of this research to infer any social, linguistic, or cultural information to the existing body of literature but to collect, measure, and interpret the available qualitative data using empirical methodologies to better understand the connection to landscape expressed via toponymic lexicons (place name descriptions). As colonialism spread to Western Montana at the end of the 18th century, Western cultural features will be referred to as Euro-American when discussing naming practices, colonialism, and linguistic affiliations to illustrate the difference between European citizens and American citizens in a post-Revolutionary War era. Likewise, since the Salish Nation has many linguistic branches of the Salish language, Bitterroot Salish, and/or Salish-Pend d'Oreille will be used to formally refer to the Native American communities who speak the dialect used in Western Montana, and Salish will be used informally when referring to the toponymic data and/or language.

Due to time constraints of a master's thesis, general size of the project objectives, and the novel COVID-19 pandemic, an ethnographic component of research has not been explored on a firsthand account by the researcher. That being said, it is important to state that while this research did not involve primary source collection, data collected for this project was obtained via ethnographic, archaeological, geographical, and linguistic case studies. Likewise, historic documents that have been published about Missoula County and other records involving ethnophysiography from early historic explorations and traditional Indigenous heritages are utilized in the research of this study. Future research involving ethnographic investigation will increase the dataset sizes for further investigation of Missoula County ethnophysiography.

Thesis Overview

The ensuing five chapters discuss the hypotheses and test expectations for this ethnophysiographic study, a literature review, methods and cross-disciplinary involvement, research results, and a concluding discussion on the importance and future of this research.

Beginning with **Chapter Two: Hypotheses and Test Expectations**, this investigation seeks to understand how the relationship between language and landscape is conceptualized through toponym lexicons and if an ethnophysiography between different toponym languages differs drastically. Since it is stated that while many Salish place names of this region embody cultural information, there are many that carry descriptive evidence which allows for a through inquiry of landscape, land cover, and Traditional Ecological Knowledge (Salish-Pend d'Oreille Cultural Committee 2005[2018]; Fagúndez and Izco 2016; and Bear Don't Walk 2019). Furthermore, statistical contributions to understand language's relationship to landscape (and vice versa) have been applied. Similar to a microtoponymic investigation of meaningful elements by Villette and Purves (2018), this toponymic investigation looks for a Zipf's Law in the data via statistical frequency analysis to understand the intentionality or lack-thereof in naming practices.

As this thesis is strongly cross-disciplinary and demands knowledge and material evidence from several fields, **Chapter Three: Literature Review** explains the body of literature that inspired, modeled, framed, organized, and executed this research. Starting with a discussion on ethnophysiography and providing background through the toponymic and archaeological records, the chapter introduces case studies utilized for ethnophysiographic exploration and a brief understanding of material and toponymic culture. Continuing with a discussion on phenomenology, language, and perception, the chapter explains the significance of utilizing an embodied theoretical framework and the importance that language and perception is to landscape. Chapter Three ends by discussing the use of GIS in linguistic and anthropological research, its capabilities and introduces its importance to analyzing this thesis' toponymic data to geographic land cover.

Chapter Four: Methods and Spatial Analysis explains the step-by-step processes of collecting data, organizing the data, analyzing the data in GIS, and statistically looking for a Zipf's Law frequency distribution. These methods are important to the research for several reasons: (i) GIS and Zipf's Law allow for qualitative data to be empirically measured without corrupting the cultural integrity of the created datasets. This methodology was constructed by referencing several published case studies in linguistics and geography where language has been spatially investigated using GIS and land cover is evaluated for geographic or ecological modeling and investigation (Henshaw 2006; Teeraranarat and Tingsabadh 2011; Sohl 2019; and Sousa and García-Murillo 2001). (ii) Implementing a statistical component not only tests the ethnophysiography of a corpus of toponym data, but also investigates the significance of the names. Understanding the inverse relationship of name frequency and rank, offers an insight to the practices of naming places and the significance those names have to their environment.

The final two chapters discuss the findings from this ethnophysiographic research and investigative deliverables regarding any issues with the data or project and future research. **Chapter Five: Results** begins with a brief overview of this thesis and introduces the findings from the previously explained methods. The figures included in this chapter involve maps, graphs, attribute tables, and land cover comparisons. Moreover, **Chapter Six: Discussion** includes a brief introduction and research summary, issues in the research, intellectual merit and future research (i.e. archaeologically, cognitively, statistically, or cartographically), and closing remarks.

Chapter Two: Hypotheses and Test Expectations

Introduction

Through the archaeological record and Indigenous Oral Tradition, it is understood that the landscape where Missoula County is located has been occupied since the Paleo-Indian Period (12,000-8,000 y.a.) or Time Immemorial (MacDonald 2012 and Salish-Pend d'Oreille Cultural Committee 2005[2018]). As previously stated in Chapter One, Missoula and its surrounding counties have been a spatial focus for many cultural, ecological, and linguistic study. The body of information regarding its landscape, social economy, heritage and more make this area a target for transdisciplinary research analysis between the social and physical scientific fields. However, an ethnophysiographic style of study has yet to be investigated. Since the exploration and settlement of Euro-Americans in the late 1700s, cultural changes to the landscape resulted in toponymic, economic, and land use changes (Division of Indian Education and Montana Office of Public Instruction 2009). These changes can be studied and analyzed with an ethnophysiographic perspective and understood through Geographic Information Systems (GIS) and frequency distribution statistics.

Hypotheses

The thesis hypotheses were developed in reference to the general ethnophysiographic hypothesis: "*people from different language groups/cultures have different ways of conceptualizing landscape, as evidenced by different terminology and ways of talking about, and naming, landscape features"* (Mark et al. 2011:36), where *naming* is the area of focus. The following hypotheses offer merit to understanding how the environment or place was and is conceptualized (or explains an ethnophysiography) by diverse cultural/linguistic groups according to toponymic lexicons and land use/cover of Missoula County.

HYPOTHESES	**TEST EXPECTATIONS**
(H1) The relationship expressed between toponyms of diverse languages and landscape should not statistically produce a Zipfian Distribution because places are named intentionally.	Expect to find that toponyms are not inversely proportional between word frequencies and word ranks which will not result in a logarithmic slope close or equal to (-1), the ideal Zipfian distribution.
(H2) The relationship of toponyms and landscape is diversely conceptualized between place names of different languages.	Expect to see that an ethnophysiography of toponyms exists in Missoula County and differs between languages of toponyms.

Test Expectations

H1 *The relationship expressed between toponyms of diverse languages and landscape should not statistically produce a Zipfian Distribution because places are named intentionally.*

Zipf's Law belongs to a family of power laws, which is a function of relative change in two quantities that are set proportional to each other (Glenn 2016). It is expected that if the toponym datasets are fitted to a power law and rescaled to a log-log plot, then a Zipfian distribution will not occur because the frequency of names for Missoula County are not inversely proportional to their rank and thus states that place names are intentionally selected according to descriptive occurrences in the landscape and not directly related to other cultural, geographical, or other features. This hypothesis is tested similar to the Villette and Purves (2018) case study of microtoponymic investigation to geographical place, however, technologies used to test for a Zipf's Law include using an online frequency word calculator, Excel, and GIS.

H2 *The relationship of toponyms and landscape is diversely conceptualized between place names of different languages.*

Since Missoula County has a profound record of varying social and physical scientific research, an ethnophysiographic research project will recognize the connection of toponymic lexicons to land use conceptualizations of diverse cultural/linguistic toponymy and land cover. Similar to how data were collected in the Chontal landscape of Mexico by O'Connor and Kroefges (2008), data collected to test this hypothesis were primarily composed from toponymic lexicons by Omundson (1961) and Aarstad et al. (2010) and Indigenous ethnographies by Salish-Pend d'Oreille Cultural Committee and Elders Cultural Advisory Council Confederated Salish and Kootenai Tribes (2005[2018]), the Plateau People's Web Portal, and Malouf (1952). The archaeological record of Missoula County was utilized as a point of reference for place utilization, however, were not mapped for this thesis out of regard for the sites' wellbeing and protection[2]. Sources referenced for this information include Bobbitt (2015), Malouf (1952, 1960, 1961, and 1962), journal entries of Lewis and Clark (Thwaites 1905[1805]); MacDonald (2012); Davis (2019); and SHPO. The methods and technology used to test this hypothesis include:

1. Creating geodatasets and georeferencing Indigenous and historic maps.
2. Using GIS for interpolative spatial analysis
3. Land cover analysis, investigation, and cross-reference

Once the dataset is created for each toponymic language and the place name descriptions are classified, several geoprocessing and interpolative raster outputs will show a change in landscape conceptualization according to toponymic descriptions- also known as an ethnophysiography. This ethnophysiography is expected to be large since land cover is

[2] Archaeological sites often fall victim to looters and is standard practice among the archaeological community to limit locational information for cartographic practice.

understood to have undergone a drastic change since the time of colonialism (Low 2017). This means that landscape conceptualizations based on toponymic descriptions are drastically different between toponyms of different languages. The measuring, calculating, and spatial analyzing will be completed in Excel and by using the ESRI ArcGIS software- ArcGIS Map and ArcGIS Pro.

Null-Hypotheses

Though the initial hypotheses are expected to be accepted for this thesis by testing them against secondary source materials and analyzing the data via geospatial technologies, the following null-hypotheses are implied:

NULL-HYPOTHESES	**TEST EXPECTATIONS**
(**NH1**) The relationship expressed by the toponyms of diverse languages, should statistically produce a Zipfian Distribution because places are named randomly.	Expect to find that toponyms are inversely proportional between word frequencies and word ranks resulting in a logarithmic slope close or equal to (-1), the ideal Zipfian distribution.
(NH2) The ethnophysiography of Missoula County is not conceptualized diversely between the different toponym languages.	Expect to see that an ethnophysiography of toponyms exists in Missoula County but the conceptualizations do not differ between toponym languages.

NH1: *The relationship expressed by the toponyms of diverse languages, should statistically produce a Zipfian Distribution because places are named randomly.*

It is expected that a Zipfian distribution will occur for each corpus of toponyms. This means that the frequency of names for Missoula County are inversely proportional to their rank and thus states that place names are randomly selected according to descriptive occurrences in the landscape and not related to land use. This is because based on the observed data sets and suggested practices of United States naming methods, a place is intentionally named according to its descriptive landscape.

NH2: *The ethnophysiography of Missoula County is not conceptualized diversely between the different toponym languages.*

Analogously to **H2**, **NH2** suggests that conceptualized landscape based on toponymic descriptions does not change between Indigenous and Euro-American naming systems. This null-hypothesis is expected to produce outputs of spatial interpolated information via GIS in which are closely related or similar with minimal to no change between the toponymic data sets. This would mean that though an ethnophysiography of Missoula County may exist, a difference in this ethnophysiography is not observed between linguistic groups of the Missoula County region.

Chapter Three: Literature Review

"Place knowledge is to geography what vocabulary is to English"

-Sauer (1939:iii)

Introduction

The following chapter describes the associated research that has influenced this thesis and contributed to the methodological construction of performing an ethnophysiographic study. Beginning with the ethnophysiographic model, the format of this chapter discusses the archaeological and toponymic significance of Missoula County; landscape, perception, and cognitive linguistic case studies; and concludes with the varied uses of GIS. Each section briefly describes the topic of interest and discusses past or current research, related phenomena, and significance to this thesis research.

Ethnophysiography

As mentioned in Chapter One, ethnophysiography is a discipline in which the conceptual relationship between language and landscape is investigated through a transdisciplinary lens. This means, according to Mark et al (2011), that a conceptualized landscape is "a continuous land surface [that become] cognitive entities" and investigates "how those entities are classified and represented in language and in thought" (Mark et. al. 2011:1). While its main model is to expand on case studies where landscape and human interactions are the research focus, several researchers such as Louis (2011) and O'Connor and Kroefges (2008) have utilized this lens to analyze specific elements of language(s) to spatial geography with primary ethnographic efforts. The relations between landscape and other human conventions have concentrated on specialties by Tuan (1974) with geography, Basso (1996) with anthropology, and language with Burenhult and Levinson (2018) (Mark et al. 2011). Conceptualization of landscape, however, is more recent and is suggested to be studied through several disciplines including toponymy (the study of place names) as seen in Villette and Purves (2018) and cognition as seen in Louwerse and Benesh (2012) and Louwerse (2008) (Mark et al. 2011). This suggests that a connection between humans and place is significant on several scales: anthropologically, psychologically, linguistically, environmentally, geographically, and promotes collaborative engagement. These collaborative efforts remove boundaries of bias pedagogies and improve upon a holistic approach in research which allows for more accurate results in both social and physical scientific environments.

While a common geographical research theme of Human-Environment Tradition (HET), originally introduced as the Man-Land Tradition by geographer William Pattison in the mid-20th century, ethnophysiography takes this research methodology of the human relationship to land and applies several sub-disciplines involving academic and community-based outreach (Mark et al. 2011 and Rosenberg 2019). Favorable linguistic focuses of landscape research, for example, are onomastics (the study of names), etymology (the study of word origins), and toponymy. Unlike HET, which is a discipline of intellectual geography where the focus lies solely on land use or activities, this thesis uses land use and land cover as a constant or a common denominator in which to study the conceptualization of place names by their descriptions/definitions to environments/landscapes and analyze the difference between toponym languages associated with place names and land use if any difference exists since it is suggested that environments transform with human presence and activities (Redman 1999). Environmental changes are influenced by one or more social or cultural factors including agriculture, urbanization, and wildlife management.

Toponyms

Today, naming practices are managed by the US Board on Geographic Names, the Foreign Names Committee (with occasional representative authority from the Central Intelligence Agency), and a geographic names board or committee on the state level (if available) (Monmonier 2015). Naming practices in the United States became more practical in nature by the end of the19th century. Prior to 1890, naming was arbitrary and left at the discretion of frontiersmen or westward settlers, and in 1906 the US Board on Geographic Names officially authorized personnel with the responsibility of place naming. These personnel were/are members of the National Parks Service (NPS), US Forest Service, and the United States Geological Service (USGS) (Stewart 1945:353-354). This responsibility included reducing duplicate toponyms and eliminating any confusing titles. In this regard, it is observed that names in the United States are closely linked with the terrain. Stewart (1945) suggests this possibility that since names are often habitual to outliving humans, nations, and languages, they can stay with the landscape even if the terrain has been altered, reconstructed, or other (Stewart 1945 and Monmonier 2015).

It was common for native English-speaking colonials to alter or rename toponyms of places, that already held a variety of linguistic backgrounds (i.e. Indigenous, French, or other) to better suit the English language (Stewart 1945:20). This method can be seen as an effort of solidifying European claims of the territory during colonization as there is a sense of permanence once a place has been named and mapped (Buckley 2006[1998] and Leonard 2021). This can often be expressed by naming sites of land parcels after those who settled the territory and held ownership during the colonization period. Examples in the Missoula region can be seen with

Present day ‘Lolo’ where the name referenced an early French trapper, Lawrence, who owned land near Graves Creek. As stated by Omundson (1961) this trapper’s burial site is still located near this territory. The present-day ‘Lolo’ underwent changes to its orthography and pronunciation due to the local Indigenous pronunciation of his name. It is described that the first documented records of this place name were “Lou Lou” or “Lou-Lou” as the /r/ sound was difficult for non-native English speakers to produce (Omundson 1961). In historic property and deed documents recorded with Missoula County, this change can be seen in Figure 15. From the earliest settler journal entries, this location was noted on cartographic sketches as “Lou-Lou” in the 1860s to early 1880s (Omundson 1961:84-86). An adjustment to this name variation was adapted in 1885 to “Lo-Lo” before its final change in 1890 to Lolo. This transition occurred slowly over time as property records illustrate variations of Lolo into the early 1900s. This location is known as *Tmsmłi* by the Salish-Pend d’Oreille, which translates in English to *No Salmon*. Historic spelling variations of this name include Tum-sum-lech, which holds the same translation (Omundson 1961 and Salish-Pend d’Oreille Cultural Committee 2005[2018]). *Tmsmłi* references a traditional creation story, which has been embodied in the name since Time Immemorial.

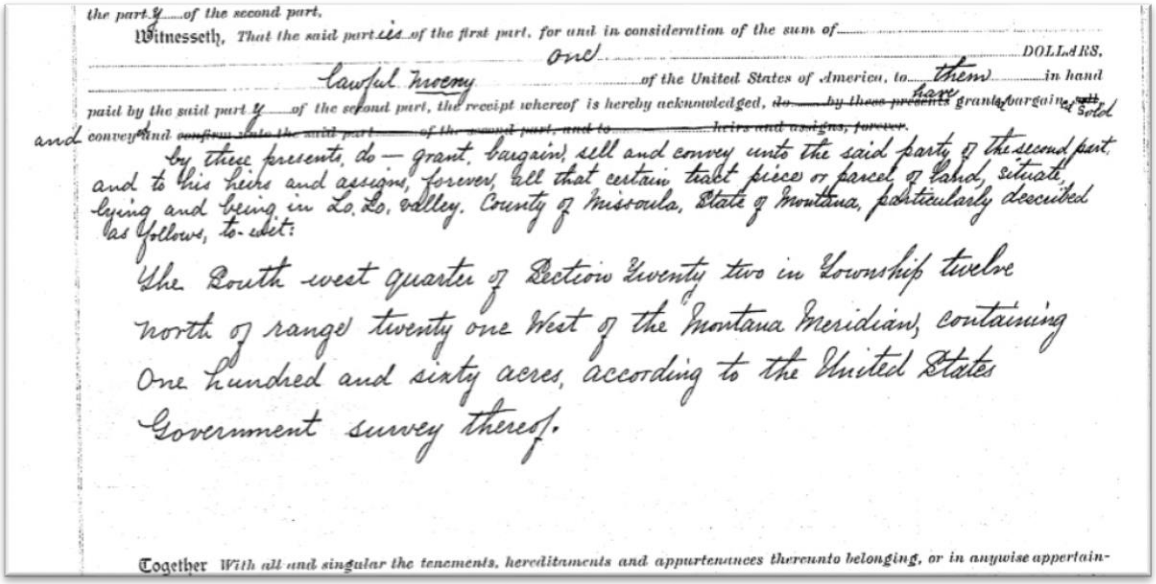
the party of the second part,
Witnesseth, That the said parties of the first part, for and in consideration of the sum of one DOLLARS,
lawful money of the United States of America, to them in hand
paid by the said party of the second part, the receipt whereof is hereby acknowledged, ~~do by these presents~~ have granted, bargained, & sold
and conveyed and ~~confirm unto the said part of the second part, and to heirs and assigns, forever.~~
by these presents, do — grant, bargain, sell and convey unto the said party of the second part,
and to his heirs and assigns, forever, all that certain tract piece or parcel of land, situate,
lying and being in Lo. Lo. valley, County of Missoula, State of Montana, particularly described
as follows, to-wit:
The South west quarter of Section Twenty two in Township twelve
north of range twenty one West of the Montana Meridian, containing
One hundred and sixty acres, according to the United States
Government survey thereof.
Together With all and singular the tenements, hereditaments and appurtenances thereunto belonging, or in anywise appertain-

Figure 15: Legal description of a transfer of real property in 1904 where Lolo is referred to as “Lo. Lo.” (Missoula County Clerk and Recorder 1904; BK27 PG558 Deed).

Linguistic methods such as borrowing, anglicizing, and reduplication are popularly observed in patterns of Euro-American place names in Missoula County. We can see this with several locations where names have gone through a process of anglicization and, at times, reclamation (i.e. Missoula (city) [*Nłʔay*] and Ch-paa-quin (formerly- Squaw Peak) [*Čpaáqn*]). Native American naming patterns are often regarded as complex since neighboring Tribes who speak separate languages may have different names for landscape features that are shared between the two or more Tribes but may not share the same lexicon or semantic reasoning. This is because language is complicated, and language translations do not always convert semantically to other languages. This means that conveyances of meanings are not universal across languages and deliver meanings which can only be understood through the language. This can also be seen in early European explorations where larger geological features or geographical monuments may have several names from English, Spanish, French, or Native nations (Stewart 1945:9). It is typical to see Indigenous names that are or have been grossly skewed due to

European pejoration and mistakes in translating or recording the Indigenous toponyms from a phonetic point of view (Monmonier 2015 and Thwaites 1905[1805]). In early westward exploration parties, journal entries of trappers, settlers, and the famously known Lewis and Clark expedition often notated and attempted to record Indigenous names of places and other linguistic observations with inaccuracies (Thwaites 1905[1805] and Catlin 1903). An example of how words and names were set askew from their Indigenous origin can be seen in ‘Missoula’, where it was initially recorded as *Isai*; the Salish Pend d’Orille *Nłʔay*- also spelled Nłʔay(cčstm) to denote the difference between the present City of Missoula (*Nłʔay*) and the area where the Salish and Pend d’Orielle would catch small bull trout (Salish-Pend d’Oreille Cultural Committee 2005[2018] and Malouf 1952). Both recorded spellings regard the place as a site for bull trout. Today, the name has been anglicized to present *Missoula* (Bear Don’t Walk 2019).

Literature on Indigenous naming patterns commonly shows both a descriptive and culturally embodied narrative to place. This does not always mean that Indigenous naming practices are unified across Tribes. For example, according to the Salish-Pend d’Oreille Cultural Committee (2005[2018]), many toponyms originate from tradition or creation stories. This is similar to the ways in which a place is encoded with agency and used to teach future generations of the past (Louis 2011) while naming methodologies by the Ononodaga Tribe of the Iroquois Nation have been observed to be descriptive in nature according to landscape or land use (Gordon 2013[1984]). Likewise, O’Connor and Kroefeges (2008) explained that during a collaborative ground truthing session in Oaxaca, Mexico, sites were named according to both descriptive and culturally relative events.

In environmental sciences, the toponymic significance can be a vital piece to understanding environmental and behavioral land use. As stated by Fagúndez and Izco (2016) toponyms are a critical source of landscape information (2016:2). This is because a common pattern of naming sites for this region, and many other American landscapes, is based on the descriptive environment including vegetative species (native or not) of a place. By deducing this information from the translation, definition, or other of a place name, landscape features can be studied which provides information to an environment's cultural usage and ecological or biological habitat. Traditional Ecological Knowledge (TEK), for example, of a landscape also denotes the importance of transdisciplinary research for vegetative predictive modeling, land management planning, cultural heritage protection, or linguistic affiliation (Sousa and García-Murillo 2001 and Hărmănescu and Popa 2013). The stories behind the current names can be shared connections to prehistoric events, traditional origins, or later historical references. An example in Missoula County of this can be seen with the Salish *Snaċłq̓ey̓mín- Place of the School*, which is now at the present-day fairgrounds in Missoula. Significant embodiment behind a place name can range from First Peoples cultural tradition stories or events, descriptive contexts, or other. This pattern is also observed in Spanish, English, and other demographic naming patterns much like Montana, which is a derivation of the Spanish word for mountains- *montaña* (Everett-Heath 2020).

Landscape, Perception, and Cognitive Linguistics

It is suggested that by the act of naming a place, landscape feature, or site, the location becomes embodied with meaning and significance according to the perceptions or experiences of those cultures/groups bestowing the name (Tilley 1994). These experiences or perceptions can be measured in a number of ways including the archaeological record, language, and geography. As Redman (1999) expressed, "environment is conditioned by human values and objectives"

(1999:203). And Basso (1996) explains, any semantic or linguistic assignment of topographical characteristics will be influenced by those representations of the communities or societies who are assigning them (1996:73). Similar to the embodied features that make up place names, so too is the space embodied, which draws importance to the body as an agent of experience itself while also experiencing an environment and its elements (i.e. smell, viewshed, sound, and- at times- taste) (Low 2017 and Merleau-Ponty 2012[1962]). Likewise, while Heidegger claims that to endure an experience with language is to take in information about language, so too can this be applied to place and space (Relph 1976; Tuan 1977; and Heidegger 1971[1959]).

With the case of Hawaiian cartographies, it is explained that a static map can embody an interactive experience of place and encodes memory through performance and agency (Louis 2011). This is because when Indigenous Hawaiian communities name a place, a part of themselves is invested into the land according to how it is realized and perceived by them. Because of this, many Hawaiian place names carry memories of events or stories and serve as cultural references for future generations (Louis 2011). Furthermore, it is argued that mental spatial representations can be collected via linguistic information as it can non-linguistically. The question here is whether or not such information can successfully be collected via linguistic frequencies as well as the common geographic, perceptual, or linguistic methodologies of representational collection (Louwerse and Benesh 2012) for scientific study. A comparative linguistic spatial frequency study by Louwerse and Benesh (2012) resulted in outcomes which conclude that language does encode spatial structure and that human cognitive maps can be drawn using linguistic and/or non-linguistic statistical patterns.

Cognitively, it is understood that a higher concentration of positive emotions are associated with outdoor environments over indoor landscapes (Bailey et al. 2018 and Bailey

2017). Studies regarding the use of virtual reality (VR) and other technologies to understand perceptions include Louwerse and Hutcherson (2012), Moss (2018), Altaweel (2021), and more. These technological methods to analyze cognitive experiences of place can be applied through archaeology (Moss 2018 and Garofoli 2019), linguistics (Tromp et al. 2017), and urban planning (Altaweel 2017). VR can be used to recreate past sites and is argued that on an archaeological plane, these reconstructed realities provide a cognitive insight to perception and experience of place via past mental structures (Garofoli 2019). Similar to Tilley's (1994) phenomenological approach to understanding past experiences of archaeological sites through material monuments, virtual reality invites an interpersonal space to study and understand cognition of the past as well as providing support for present and future cognitive underpinnings. This means that similar to the use of VR in the archeological realm, the modern planes of landscape and management can also benefit and provide a knowledge into perceptions of place according to culture, language, and experience through neurophenomenological study. Neurophenomenology is a branch of the phenomenological theory in which an integration of three elements are applied to research- (i) experience analysis, (ii) behavioral systems knowledge, and (iii) pragmatic investigations of parallels to biological schemes (Gallagher 2010). This understanding of cognitive research is relevant to this thesis through the phenomenological underpinnings of this research. It is important to recognize where this research has the opportunity to expand in order to understand how perception in landscape can be investigated without the direct investigation of physical consciousness, but by the use of perception through language similar to Zwaan (2003).

Zipf's Law

Zipf's Law belongs to a family of power laws, which explain the functional relationship between two quantities. This means that when two phenomena are set proportional to each other, a relationship can be expressed and fitted to a statistical plot to understand this relationship and observe how well the data fits. Many phenomena follow a power law including the frequency of words in a language or human ecological patterns (Lestrade 2017 and Newman 2005). Zipf's Law was developed initially by linguist George Kingsly Zipf to understand word use frequencies in language and has popularly been used in quantitative linguistics (QL), toponymic research, and human geography (Villette and Purves 2018; Glenn 2016; Thurner et al. 2015, and Pantadosi 2014). It has since been used for linguistic and geographical studies and illustrates the relationship of word frequencies to landscape.

In toponymy, place names convey spatial information and can be statistically researched to understand the connection that language has to place. Villette and Purves (2018) for example investigate meaningful elements of place names to statistically see the relationship names have to place via an ethnophysiographic lens. This thesis references their study to see if the toponymic datasets fit a power law, rescaled to a log-log plot and are expressed by a Zipfian distribution. This goodness of fit will statistically observe the intentionality of place names of Missoula County and confirm whether places are assigned names randomly or intentionally based on descriptive landscape features.

Archaeology

It is understood that as of the mid-1900s, Montana could be broken up into three main regions according to the material culture of prehistoric periods as shown in Figure 16 (Malouf 1960:16). However, this diagram is now considered outdated and used here only for historic referencing purposes. Archaeology in Montana is argued to have initially began with the Lewis and Clark expedition and thus resulted in archaeological and cultural observation for this region via their documentation of the journey in 1804 to 1806 (Malouf 1961). While evidence suggests present-day surrounding states transitioned to agricultural subsistence patterns nearly 2,000 years ago, the traditional hunter-gatherer practices continued in Montana until Euro-American colonialism in the 18th century (McDonald 2012). The knowledge base of the Early Peoples of the Montana environment is extensive with intelligence of flora and fauna collection and usage (McDonald 2012) and has been passed down for generations through oral traditions and Tribal lifeways (CSKT 2021). In several instances from the literature, patterns of naming sites involve such resource allocation and land use substances (Fagúndez and Izco 2016; Omundson 1961; and Salish-Pend d'Oreille Cultural Committee 2005[2018]). Other patterns of early naming practices in the area are found in traditional creation stories and access or seasonal trekking patterns to hunting, fishing, and social events (Malouf 1952; Omundson 1961; and Salish-Pend d'Oreille Cultural Committee 2005[2018]). The region involving present-day Missoula County often has sites in which the description of a toponym was/is shared by more than one Tribe of the area before non-Indigenous settlement. Though the direct English translation of these names may not be common, the land use is occasionally mutual. An example of this can be seen with the route to the bison during a seasonal hunting tradition where this path is referred to as *Smítu Sx̣ʷcuʔsí* by the Salish and Pend d'Oreille and *k ̓uysey ̓ne ̓iskit* by the Nez Perice. Both names denote a semantic definition of traveling to hunt bison in the eastern plains of Montana (Salish-Pend d'Oreille Cultural Committee 2005[2018]). However, the translation of these names refers to separate conclusive events while journeying on these paths.

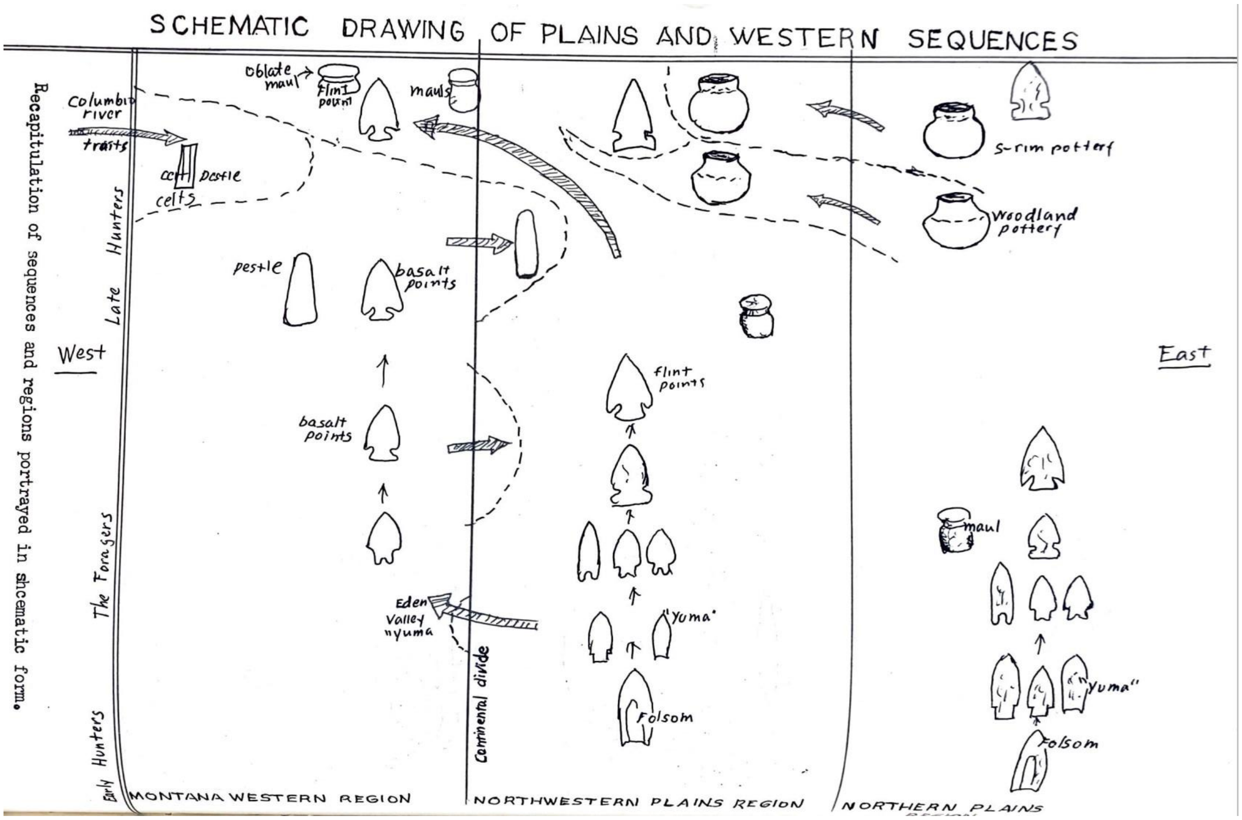

Figure 16: Tendency of Westward movements according to archaeological artifacts (Malouf 1962:16)

Today, we know this trail as Lewis and Clark Pass and the Lolo Trail, which are national and state historic preservation sites. Similarly, *Smítu Sx̣ʷcuʔsí* was named Lewis and Clark Pass after Euro-American colonialism of Montana due to the western exploration led by the Lewis and Clark party. One site example from which a place name is directly related to this expedition can be seen at Travelers Rest, where the Lewis and Clark party camped at the advice of Indigenous guides who aided the expedition (see Figure 17). The name remained and embedded historical information for a site to rest while traveling through the valleys. Today, this site is a historical marker and is classified as a Park according to the GNIS database. Likewise, anglicization of Indigenous names was/is common and can be seen in sites such as Missoula and Skalkaho Pass. From the observable data and literature on Missoula County place names, the naming of some places does suggest some intentionality according to specific factors that make up an environment or space but is not unique to any one culture or occupational period. This can be seen at sites such as Lick Lake where a geological occurrence of natural saline draws numerous species of wildlife to drink from its waters, and *Tmsmłi* - a site that addresses the lack of salmon to be found in its waters

Figure 17: Traveler's Rest to Lolo Trail journal entry in an elk-skin bound journal. Lewis and Clark Journal- September 11-12, 1805 (Missouri Historical Society. "Journals of the Lewis and Clark Expedition" Link).

from an oral creation tradition, which has been a part of the Salish culture since time immemorial. According to the Salish Tribe, stories of creation often relate to specific spatial environments, which explain the origin of life as well as the complex connections people have to the landscape (Salish-Pend d'Oreille Cultural Committee 2005[2018]:7). It is told in Salish tradition that the natural environment provides all the necessary ingredients for living in a place so long as acknowledgement is reciprocated to the land (Bear Don't Walk 2019). Many of the descriptions behind Salish place names of Missoula County originate from the traditional creation stories of the tribe. The information behind such names offers knowledge to cultural traditions of resource gathering, presence of diverse species of plant and wildlife habitats and habits, as well as occupational timeframes which often cross-reference with geological and archaeological phenomena (McDonald 2012; Malouf 1952; Salish-Pend d'Oreille Cultural Committee 2005[2018]; Bobbitt (2015); and Omundson 1961).

Human geography is important in many ways because it provides an insight to the relevance human environment has to culture, society, and other attributes that make up the body of humanity like language (Tuan 1977; Burenhult and Levinson 2008; Bear Don't Walk 2019; and Bobbitt 2015). Research involving this importance includes studies in phenomenology and uses GIS to understand qualitative data in a quantitative practice. As stated by Rouse (2018) however, this process of collecting cognitive social data for quantitative analysis through GIS is not always simple. His solution to this is that GIS can be used to create a model that can build from an expressed experience of the landscape or can infer towards an experience depending on methodology and practice. By analyzing cultural, social, economic, and other aspects of human occupation with a phenomenological perspective, then land-use, subsistence patterns, and non-pragmatic knowledge can be examined (Sohl 2019; Fagúndez and Izco 2016; Bear Don't Walk

2019; Bobbitt 2015; Dixson 2014; Hedblom et al. 2019; and Sousa and García-Muillo 2001). The importance of landscape to humans can offer research focused on the experience of an environment from an individual and/or community-based perspective via phenomenological practice (Rouse 2012; Sauer 1939 and 1963; Higuchi 1988; Tilley 1994; Tilley and Daum 2017; Falk 2010; Gillings 2012; and Zube 1976). The use of GIS in landscape research has provided insight into many different methods and techniques for development of research in understanding environmental patterns on a social and physical scientific level.

GIS and Cross-Disciplinary Research

Geographic Information Systems (GIS) is a computer mapping and spatial analyst software in which data can be investigated for many reasons such as geostatistical sums for glacial research or predictive modeling of wildlife habitats of the past or the future. Though bountiful with spatial and 3D analyst capabilities, its functionality serves use for many diverse disciplines, professionals, and data or phenomena. At times, these capabilities seem endless, and when an end seems to be near, problem solving to overcome an obstacle with GIS's geoprocessing toolbox is an accomplishment in itself. These hurdles with regards to the social sciences have been directly addressed in the last several decades by those who utilize GIS in anthropology, linguistics, psychology and more (Yeginbayeva et al. 2006; Larrain and McCall 2018; Zeini 2018; and Renell 2012). Such an example for spatially analyzing linguistic dialects can be seen in Figure 18. Likewise, trending efforts aimed in research to bridge the gap between qualitative and quantitative analysis have also turned to GIS to bring these two scales of science together on a more equal plane for more conclusive synthesis and data (Rouse 2018). Thus, from the body of research and with the continued growth of the GIS technology, GIS applications have suited nearly all fields involving people, environment, and everything in between (Lee, Quao, and Han 2017).

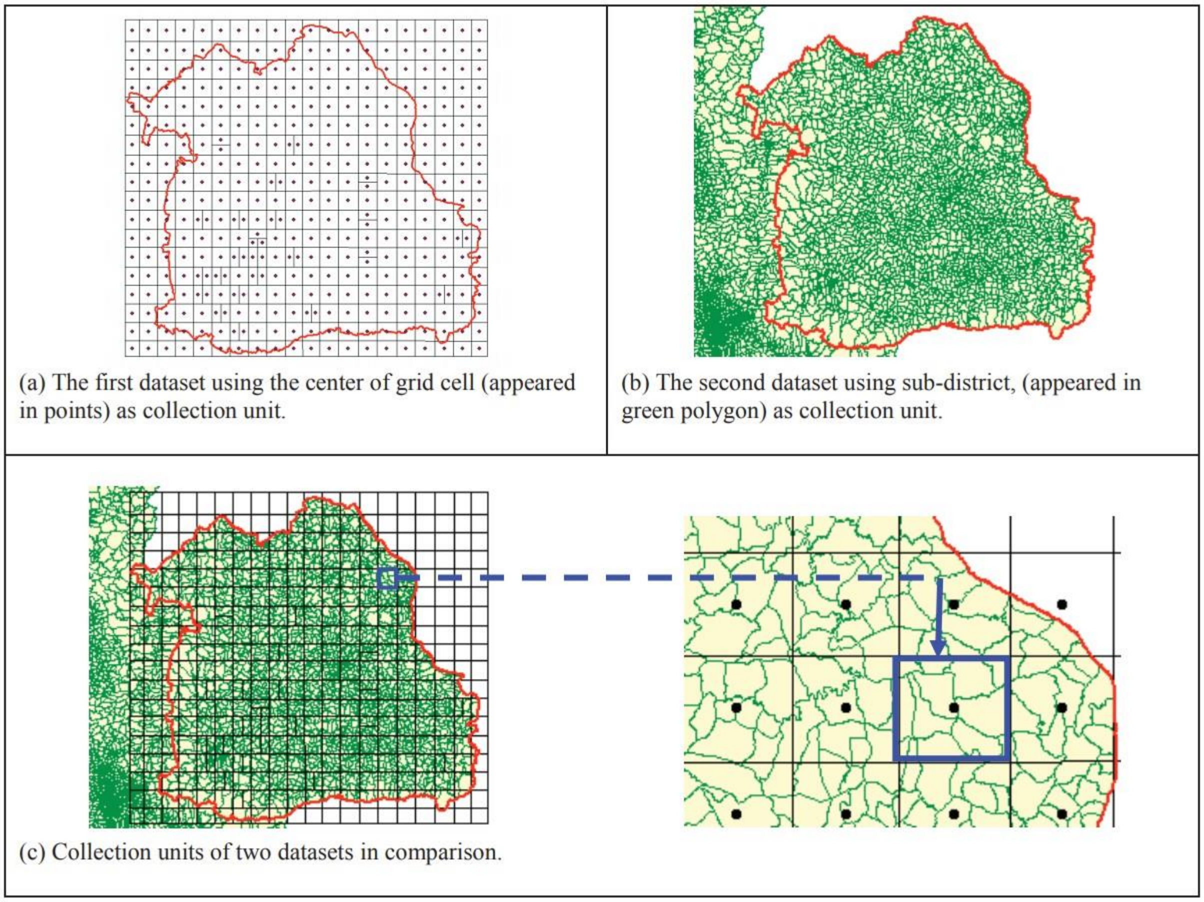

Figure 18: Example of linguistic dataset collection, organization, and analysis via a grid and centroid methodology in GIS by Teerarojanarat and Tingsabadh (Fig. 2011:365).

As mentioned earlier in this chapter, a popular linguistic avenue of research is in toponymy, but language studies in general are also expressed in cartographic means similar to the maps displaying information on language movements or changes and Native North American language groups as seen in Figure 19. On a focused level, dialects, accents, and other linguistic features can also use GIS to study the spatial relevance, distribution, or change. One example of this can be seen in Figure 20, where an isorhythmic map of the contiguous United States displays regional language differences. Intricate linguistic and geographic research regarding fictional languages and place, similar to Kurtz's (2013) literary mapping and sense of fictional place project and Louwerse and Benesh's (2012) spatial structure representation from J.R.R. Tolkien's fictional world, utilizes the denominating elements in geography regardless of their fictional existence.

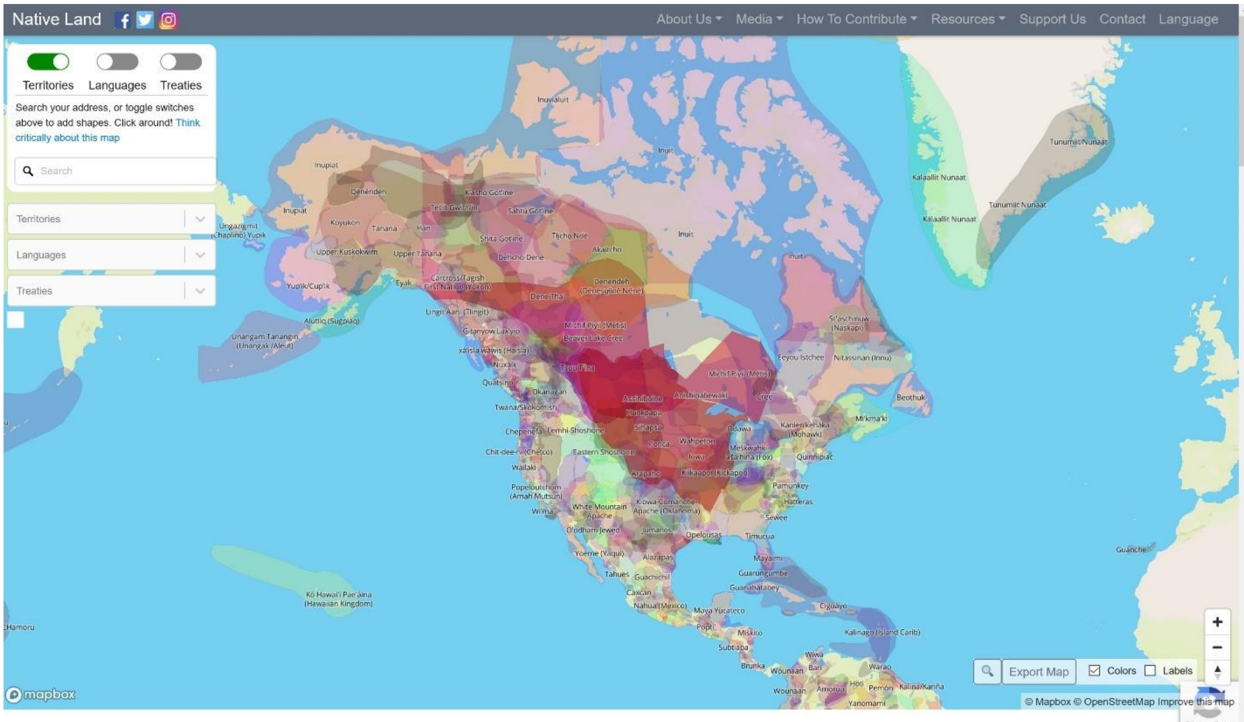

Figure 19: Interactive online map of Indigenous languages, Tribes, and treaties around the globe. (Link)

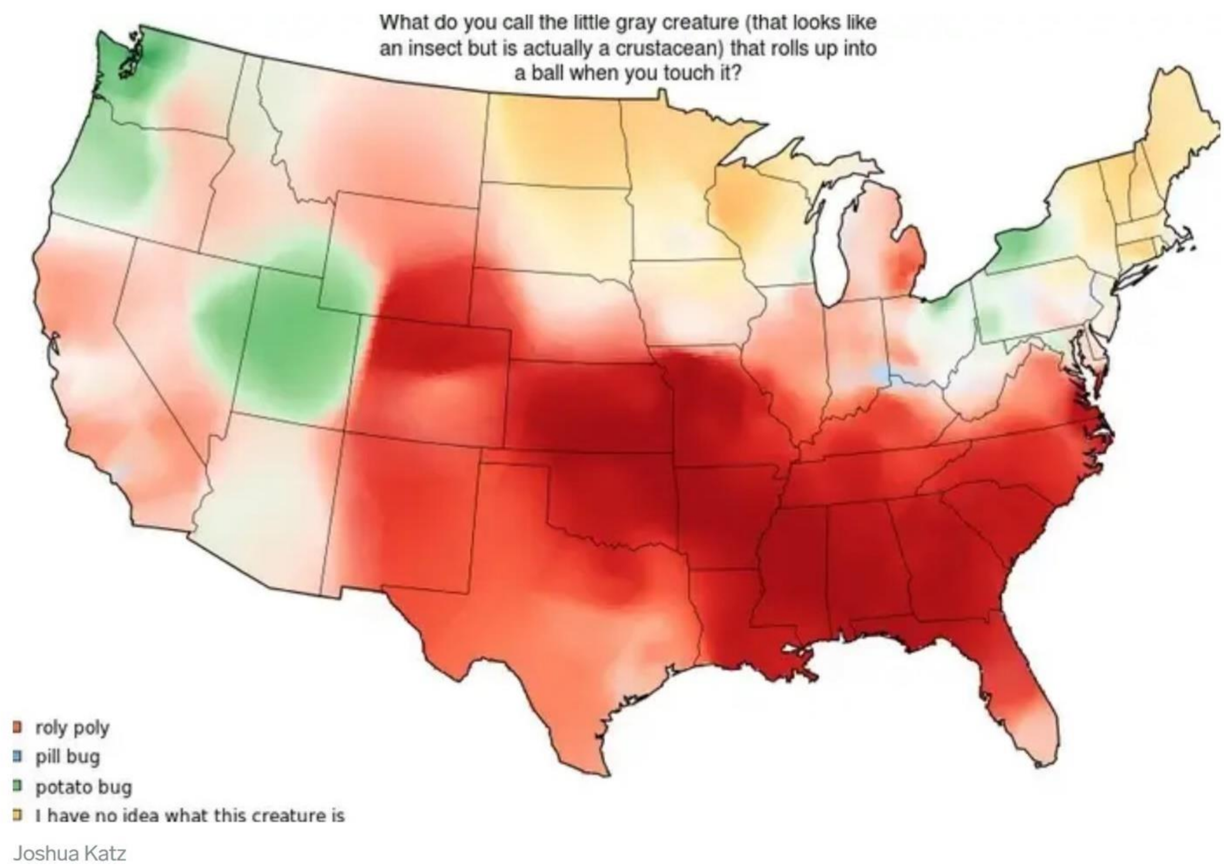

Figure 20: Dialectal isarithmic map of regional terminology in the contiguous United States by Katz (2018)(Abadi 2018).

With regards to place names, GIS has been used in a number of ways to study the relationship between person and environment by focusing on toponyms. Names identify and embody information pertaining to the environment, culture, language, geography, and heritage (Calvo-Iglesia 2012). One such case study referenced for this thesis is Louis' (2011) investigation of Hawaiian place names and story traditions and carries a theme of geographic/cultural revival. She claims that similar to the traditions of Western mapping practices, so too are Hawaiian maps based on "social constructions of spatial knowledge" with a difference in developmental methods (Louis 2011:169). Likewise, Chloupek (2018) utilizes GIS to study the relationship of spatial statistics to historical information which employ a qualitative analysis on qualitative data. This use of GIS to quantifiably measure social data expressed through toponyms is discussed by Fuchs (2015) with suggested methodologies by Rennell (2012). This movement of utilizing GIS for data transformation and investigation is because maps are important and provide and represent cultural characteristics (Leonard 2021 and Dunn 2007), mental and cognitive information about space and place (Louwerse and Benesh 2012 and Bailey et al. 2018), and political or economic information (Crampton 2002 and Alteweel 2017).

Chapter Four: Methods and Spatial Analysis

Introduction

The following chapter describes the methodologies used to collect data, spatially analyze the relationship between toponyms and landscape (the ethnophysiography), and the software and tools used to produce the results of this study. In order, the methodological goals of this thesis are to use an ethnophysiographic model to collect information for spatial and statistical investigation in GIS and Excel. Since the literature has shown examples of both descriptive and culturally relative naming patterns, three steps are taken to understand the ethnophysiography. Firstly, toponym datasets are fitted to a Zipfian distribution to analyze the intentionality of a place name and its place. Secondly, toponymic descriptions are measured for an ethnophysiography to understand if landscape conceptualizations based on toponym descriptions differ across toponym languages. Thirdly, the toponyms are cross-referenced with land cover data to identify the direct connection (if any) to a landscape via its place name.

To test my hypotheses, the following methodology explains how GIS is used to investigate the ethnophysiography of this research, which directly addresses **Hypothesis 1 (H1)** *The relationship expressed between toponyms of diverse languages and landscape should not statistically produce a Zipfian Distribution because places are named intentionally*, and explain how the datasets were fitted to a log-log graph to observe if a Zipf's Law exists as addressed by **Hypothesis 2 (H2)** *The relationship of toponyms and landscape is diversely conceptualized between place names of different languages.* A Zipf's Law will explain the intentionality associated with these toponyms by statistically fitting the data to a power law curve. A Zipfian distribution explains patterns in the data that reveal the connection to descriptive or non-descriptive naming practices. These research components are important to this research to fully understand how place names relate to the landscape and to understanding the conceptualizations of this relationship through toponymy and land cover. The ensuing list is an order of operations to collect and perform the research:

1. Identify toponyms of the Missoula County region with a thorough investigation of secondary source material including publications by Aarstadba et al. (2009), Omundson (1961), Salish-Pend d'Oreille Cultural Committee (2005[2018]), Malouf (1952), and organizations such as the Geographic Names Information System (GNIS), the University of Montana (UMT) special collections archives, and more.
2. Collect data points to comprise a geodatabase of toponyms where descriptions of the place name origins are defined and spatially referenced. This is done by simplifying the data to a manageable sample size by limiting spatial toponyms to non-urbanized landscapes (i.e. recreational, managed, or forested terrain).
3. Classify the names in the data sets according to their descriptions and assign numerical labels for spatial calculations in GIS. These classifications were created specifically for this research but are referenced based on toponymic classification rhetoric by Stewart (2013[1954]), Brabyn (2009), Sletto (2009), and Thornton (1997). The classes and their definitions can be seen in Table 2. Since this thesis deals with place names in two different languages (Salish and English) names are only classified according to their descriptions and not by names translated to English. All of the names used for this thesis have descriptive provenience and/or are translated to English. Names that did not have this information were not used for this study but are available via secondary source material for future research.

4. Fit the toponym datasets to a power law curve and rescale the data to see if it fits a Zipfian distribution. This is done in Excel after running the toponyms of each language through an online word frequency counter which lists the meaningful elements from each name according to how many times each meaningful element occurs. This list is then exported to Excel where the frequency of those elements are assigned a rank, the logarithm of the rank and frequency are calculated, and plotted on a log-log graph where the data can be analyzed in relation to a Zipf's Law.
5. Download relative vector shapefiles and raster data for county, state, land cover, and modern place name layers. These layers denote the spatial relevance to the region of interest and are used to clip the large raster files (land cover) to the necessary spatial size for analysis. These data sets are available for open access download from the Montana GIS Clearinghouse.
6. Georeference maps, and other point/toponymic data using the GIS Georeferencing toolbar. These maps are available online or in state archives from the Montana Memory Project, the Plateau People's Web Portal, UMT Special Collections, the Map Missoula project, and the Montana State Historic Preservation Office (SHPO).
7. Create a fishnet (grid) over the area where the points exist spatially to keep the data organized for an ethnophysiographic investigation. This refers to Missoula County and surrounding areas and roughly follows the Public Land Survey System (PLSS) Township and Range cadastral grid. Referenced literature for this methodology includes Bobbitt (2015), Ryan (2018), and Teerarojanarat and Tingsabadh (2011:365).
8. Measure the ethnophysiography of a sample of Missoula County toponyms in GIS using surface interpolation and geoprocessing tools. These tools will illustrate the distribution

of points (toponyms) according to their classified conceptualizations via their descriptions. After converting the point layers to raster layers by using these interpolation tools, the two toponym datasets can be compared to (i) understand the ethnophysiographic difference among toponym languages and their (ii) relationship to landscape via land cover.

9. Interpret land cover information to cross-reference the toponymic raster layers. This is done by first creating a protohistoric land cover layer from information provided by the toponym land use and cover descriptions and render the data via the Natural Neighbor interpolation tool in ArcGIS. The 2016 land cover layer downloaded from the Montana GIS Clearing House is simplified according to the land cover where each point resides in reference to the land cover layer then rendered with the Natural Neighbor tool. This done to visually see the change between the protohistoric and the 2016 land cover data on similar scales since a 30-meter resolution land cover of the protohistoric era cannot be created this scale as the modern land cover layers are. This is a means to observe change between early land cover layers and modern land cover layers to denote the relationship to place names prior to colonialism.
10. Use the unmodified 2016 land cover layer as a constant base to calculate the allocation of place names to landscape in the Missoula County region. This empirically demonstrates the ethnophysiography of the study area by illustrating the relationship of place names to land cover using graduated symbols and a classified stretch type in GIS.

Toponym Data Collection and Classification

We know from the archaeological record and Indigenous heritages (Salish-Pend d'Oreille Cultural Committee 2005[2018]) that the First Peoples of North America experienced the Missoula County region during the glacial lake periods from the time of the Paleo-Indian (Davis 2019). As described by MacDonald (2012) archaeological records show occupation periods of Montana as three main periods: Paleoindian (11,000 to 8,000 years ago), Archaic (8000 to 1500 years ago), and Late Prehistoric (1500 to 300 years ago), while the Historical period is 300 years ago to present (2012:1). For this region, the protohistoric period was briefly seventy years where the Lewis and Clark expedition motivated colonialism into the region with their intentions to document, establish trading networks, and uphold or spread the United States' dominion in the post-revolutionary war era (Buckley 2006 [1998]). Informative accounts of terrain soil types, floral and fauna habitats and collections, climate, and Indigenous land use traditions and language notations were recorded in the journals of Meriwether Lewis and William Clark (Buckly 2006[1998] and Caitlin 1903).

These first-hand accounts of the landscape and cultural interactions provided a wealth of background information for framing the data according to early land cover and land use parameters as well as initial surveying by the General Land Office (GLO). Further, toponymic data was collected from ethnographic reports by Malouf (1952, 1960, and 1961), Indigenous authored tomes (Salish-Pend d'Oreille Cultural Committee 2005[2018]), and lexicons (Omundson 1961 and Aarstad et al. 2009). *The Salish People and the Lewis and Clark Expedition*, for example, is a compilation of traditional heritage stories, Tribal histories, place names, and the Euro-American encounter written by the Salish-Pend d'Oreille Culture Committee and Elders Cultural Advisory Council Confederated Salish and Kootenai Tribes. Out of respect for the Tribal creation stories, which are written in this volume where certain place names have cultural and seasonal descriptions, they will not be discussed in detail in this thesis, but will be referred to when necessary descriptions of place names or place need to be discussed. These descriptions often occur when a name references the Coyote story, which is only to be discussed during the winter months. From these bodies of literature, the place name was recorded in an Excel spreadsheet in the corresponding language (i.e. Salish or English) along with its description, translation (if not English), and associated cultural origins. Once the names and their onomastic origins have been recorded, spatial coordinates (UMT) were cataloged with the associated toponym. These coordinates for the Indigenous toponyms were collected and cross-referenced from the literature, georeferencing historic and Indigenous maps, and aerial imagery from USGS Earth Explorer and Google Earth as seen in Figures 21, 22, 23, and 24.

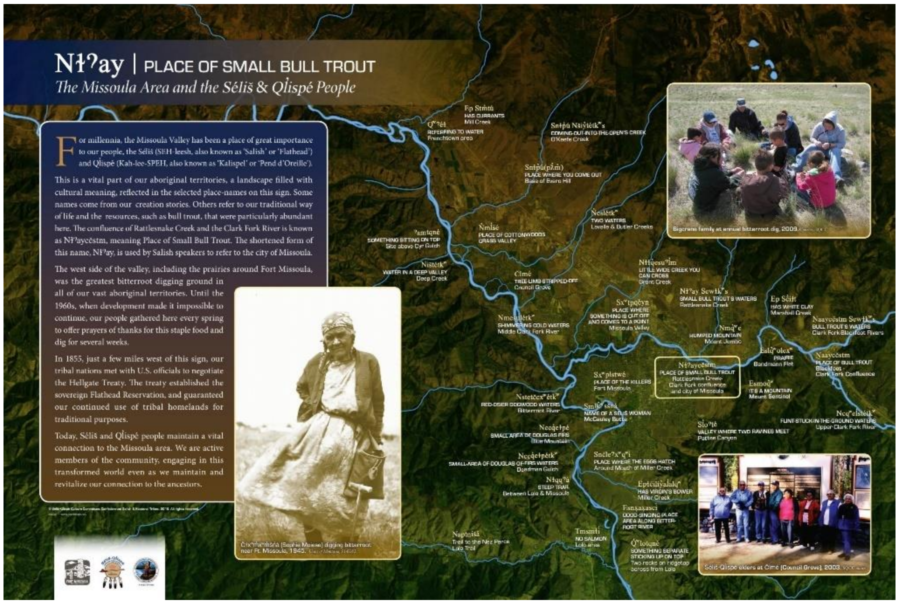

Figure 21: Salish place name map of Missoula. This map was created by the Séliš u Ql̓ispé Culture Committee for the use by both Tribal and non-Tribal instructors. This map was designed for the Bitterroot Valley and Place Names program on the Plateau Peoples' Web Portal.

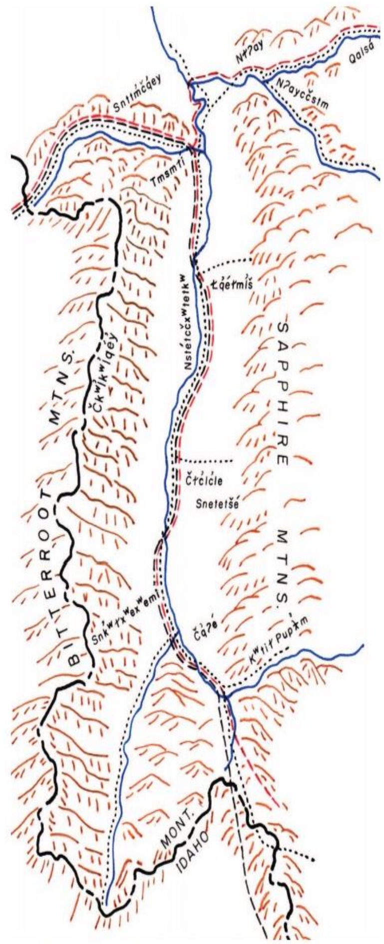

Figure 22: A Salish Place Name map by Durglo Sr. (2002) published in *The Salish People and the Lewis and Clark Expedition* (2005[2018]) and featured online by the Missoulian (2016).

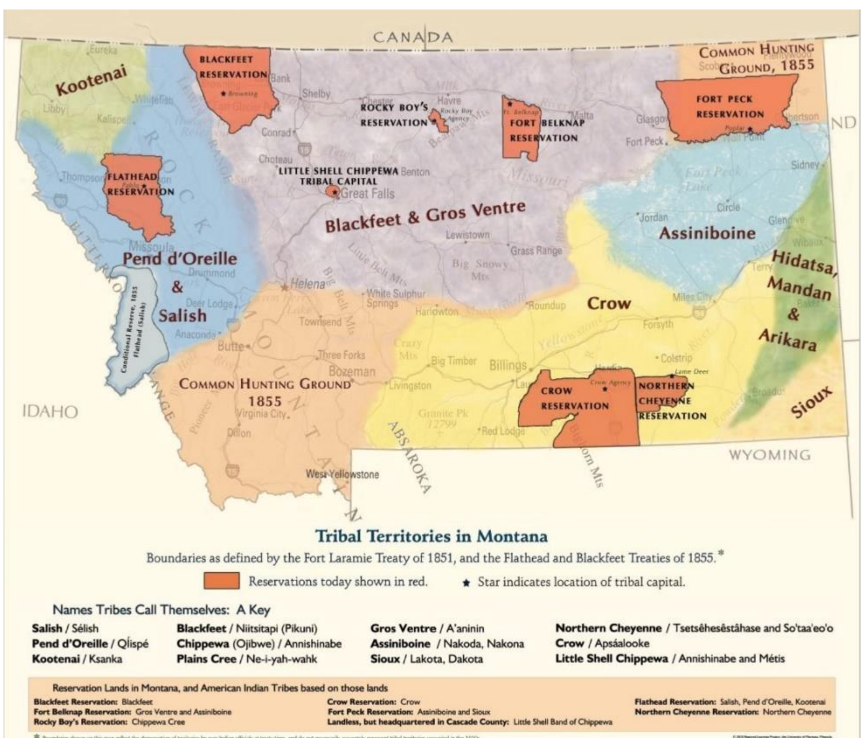

Figure 23: Historic Tribal territory map defined by treaties from 1851 and 1855 via Montana State University- Indian Education for All curriculum.

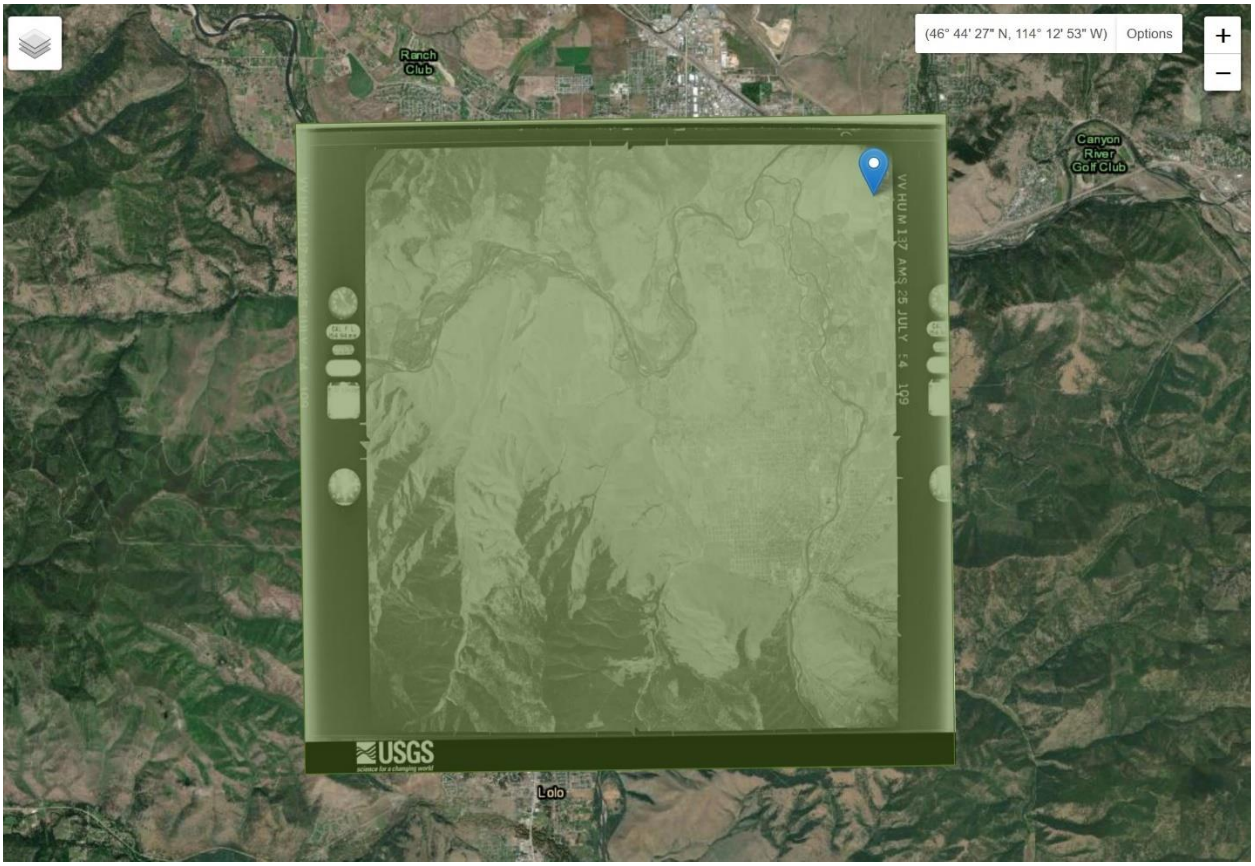

Figure 24: Image of the Earth Explorer online platform through USGS displaying an aerial image of Missoula, MT (1954).

After the available toponym data was collected and organized, the compiled spreadsheet had the following field data:

Fields	*Field Descriptions*
Lat and Long	Latitude and Longitude coordinates collected from literature, maps, and imagery.
PLSS	Public Land Survey System Township, Range, Section descriptions (if any)
Place Name	Name of place in original language of the culture
Translation	Name translated to English if not already in English
Present Location	Where the site described is presently located based on the descriptive contexts from the literature and by georeferencing historic and Indigenous maps.
County	Present day county the coordinates/name or point currently reside
Elevation	Estimated elevation of the location based on the present location recorded in the Geographic Names Information Systems (GNIS) online database

GNIS ID	Present location information from the GNIS database is assigned an identification number. This column is for reference purposes only
USGS Class	United States Geological Survey (USGS) classifies toponym information based on land cover/location information
Description	Information about how or why the place was named, linguistic breakdowns, and/or land use narratives.

Table 1a: First ten attribute fields created for organizing and compiling toponym data.

Once this information was assembled, the following fields were added for spatial analysis in GIS:

Fields	*Field Descriptions*
Class	Each name was classified based on the descriptions of the place name and use of the location/site, which denotes its conceptualization to the environment.
Translation Class	Place names classified based on their translation into English- used only for reference purposes
Land Cover System	Each name was classified according to the associated land cover Ecological Systems. Data gathered from cross-referencing point layers (names) and land cover layers in GIS.
Land Cover Descriptions	Description of landcover based on the literature
Class Value	Numerical value assigned to each class (8) for classification purposes and analysis in GIS. No numerical hierarchy was applied to the actual nominal data.

Table 1b: The remaining five attribute fields that were added for land cover information.

Two approaches were taken to classify the data- toponymic and land cover. The toponymic data collected represents a small sample of names which refer to areas predominantly used as recreation, public or protected, vegetative, and wildlife habitat land. Since the quantity of place names is extensive, the data were simplified to exclude populated places and urbanized land use to monitor the spatial analysis process and to conduct the analysis within a timeframe suitable for a master's thesis. This data collection method is followed by Omundson (1961) for his place name dictionary of Missoula County names, and references Abdikhalikovna (2020) and Stewart's (1954) description of naming methodologies in North America. Likewise, the datasets for the toponymic data were then classified into eight categories referencing Stewart's toponymic classification process and organized similar to that of the GNIS domestic names system. These eight classes (as seen in Table 2 and 3) represent descriptive information of why the place was named and is initially classified according to (if any) importance of a site was specifically discussed. This means if a place was named for both an animal habitat and a root which was gathered but was defined as being named for the importance of the place because of the vegetative features, the name was classified according to its floral properties over its fauna references.

CLASS	DEFINITION	VALUE
Access	A name referring to travel routes for different events (such as traveling to a neighboring or other Native tribe, traveling to a hunting/gathering area or seasonal occupation sites) and places. Often satellite camps cross reference with these trail systems. OR historic accessibility between settlements and/or uses for travel between sites.	5
Animal	An area predominantly known for hunting of fauna (including deer, bear, buffalo, beaver, mountain goat, elk, fish (bull trout and salmon), and antelope). OR an area named for a specific species or general animal presence/habitat.	4
Camp/Urban	An area predominantly known for satellite campsites utilized by Native American community members during travel, seasonal occupation, hunting, or gathering (*Camp*). OR Referring to a site of historic settlement significance that denote populated locales and/or human residential occupations (*Urban*).	6
Geographical	An area named or identified due to the geological/geographical features (i.e. medicinal use, geologic affinities, land cover, or location). OR an area named for significant weather or climate events, or in direct geographic relevance. OR an area named for geographic and/or cartographic relevance.	2
Human/Native	An area referencing a traditional cultural significance or heritage of the site (such as cultural origin stories or tribal oral histories). OR An area named or identified due to the settlement or development of a man-made feature. OR an area named for an individual involved with a specific event or other. OR a historic site referring to a Native American connection or history to the place.	7
Traditional	An area named or identified for social, political, or other form of gatherings, land use, or cultural conventions. OR named for reverence to a Native American event or story for which a place was named in English.	8
Vegetation	An area predominantly known for gathering of flora (including bitterroot, camas root, wild berries, sunflowers, huckleberries, or other). OR due to the presence of a specific vegetation type in the area.	3
Unknown	Referring to a site of significance with an unknown toponymic origin or definition. In the data set, this category is listed as "Null" for attribute tables in GIS.	9

Table 2: Toponymic classifications and classification definitions.

CLASS	DEFINITION
Census	A statistical area delineated locally specifically for the tabulation of Census Bureau data
Falls	Perpendicular or very steep fall of water in the course of a stream (cascade, cataract, waterfall).
Flat	Relative level area within a region of greater relief (clearing, glade, playa).
Gut	Relatively small coastal waterway connecting larger bodies of water or other waterways (creek, inlet, slough).
Lake	Natural body of inland water (backwater, lac, lagoon, laguna, pond, pool, resaca, waterhole).
Locale	Place at which there is or was human activity; it does not include populated places, mines, and dams (battlefield, crossroad, camp, farm, ghost town, landing, railroad siding, ranch, ruins, site, station, windmill).
Populated Place	Place or area with clustered or scattered buildings and a permanent human population (city, settlement, town, village). A populated place is usually not incorporated and by definition has no legal boundaries. However, a populated place may have a corresponding "civil" record, the legal boundaries of which may or may not coincide with the perceived populated place. Distinct from Census and Civil classes.
Range	Place or area from which commercial minerals are or were removed from the Earth; not including oilfield (pit, quarry, shaft).
Reservoir	Artificially impounded body of water (lake, tank).
Stream	Linear body of water flowing on the Earth's surface (anabranch, awawa, bayou, branch, brook, creek, distributary, fork, kill, pup, rio, river, run, slough).
Summit	Prominent elevation rising above the surrounding level of the Earth's surface; does not include pillars, ridges, or ranges (ahu, berg, bald, butte, cerro, colina, cone, cumbre, dome, head, hill, horn, knob, knoll, mauna, mesa, mesita, mound, mount, mountain, peak, puu, rock, sugarloaf, table, volcano).
Swamp	Poorly drained wetland, fresh or saltwater, wooded or grassy, possibly covered with open water (bog, cienega, marais, marsh, pocosin).
Valley	Linear depression in the Earth's surface that generally slopes from one end to the other (barranca, canyon, chasm, cove, draw, glen, gorge, gulch, gulf, hollow, ravine).

Table 3: A short list of GNIS place name classifications and class definitions on the USGS-GNIS online database.

From the literature, naming practices are observed to extend to methods that constitute geographical positioning and relevance (i.e. Nine Mile Creek), events that took place (i.e. Council Grove or *Člmé*), ecological habitats (i.e. Bitterroot River or *Nstetčcxʷetkʷ*), access routes to other places (i.e. the Lolo Trail (Historic) or *Naptnišá*), temporary and permanent settlement sites (i.e. Ross's Hole or *Kʷtíł P̓upƛ̓m̓*), resource collection or allocation sites (i.e. Bonner or *Ṇaaycčstm*), and geologic reference or descriptive viewsheds (i.e. Lick Lake and Mount Jumbo). Other practices include site names that are a play on words such as Cahoot Gulch, names that refer to an ethereal experience such as Angel's Bathing Pool or follow a namesake/eponym for various accounts such as Lolo (named after a French trapper).

> "In the latter 1920's 'Cap' Eli Laird looked at the steep rock cliffs surrounding the nearly inaccessible lake and exclaimed, 'Hell, only an angel could get out of there.' He later decided on the name 'Angels Bathing Pool" (Omundson 1961:17)

For the Native American data set, some references to other Tribal names are discussed for the Missoula County area, but since the predominant occupation of Western Montana is the Salish, Pend d'Oreille, and Kootenai Tribes, the data collected for the protohistoric toponyms concentrates on the Salish toponymic source material. Thus, the data for Indigenous toponymic investigation is in the Salish language- where landscapes are/were utilized, named, and known by the Salish and Ped d'Oreille Tribes. Coordinate data for the Salish toponym data set was collected from georeferencing Indigenous maps from the Salish-Pend d'Oreille Culture Committee, Tribal Preservation Office, and the Plateau People's Web Portal in ArcGIS Map or from spatially descriptive information from the secondary source material.

Although many cartographic and linguistic reports have been published on the Salish-Pend d'Oreille place names, the majority of the data available for the description behind these names was available through *The Salish People and the Lewis and Clark Expedition* (2018). Little information from other ethnographic sources directly relating to the Indigenous place name of a site was not in Salish-Pend d'Oreille Cultural Committee (2005[2018]). One example of this can be found in *Ep Smc̓ec̓- It Has Groundhog*- a place known to the Salish-Ped d'Oreille where these marmots were caught in large quantities for roasting (Malouf 1952). Today, the name of the creek that runs through this area is named after this translation- Woodchuck Creek, which is a common Euro-American naming practice according to Stewart (1945).

According to the geographic names shapefile composed by the Montana Geographic Names Framework (MGNF) and downloaded from the Montana GIS Clearinghouse online database, there are roughly 1,636 names pertaining to federally recognized locational and cultural features of Missoula County synonymous with the GNIS database. This means that of the 1,636 place names this body of names does not include major highways, interstates, or roadway systems. Likewise, after reducing the data set to exclude urbanized classified data (i.e. populated places, locales, and other) and keep those classified to match the current land cover of the county (i.e. forested, stream, summit), 714 names remained. Some individual profiles of names offer insight to the onomastic background of the toponym on the GNIS database, however, the bulk of the information gathered of place names since 1923, was collected from Omundson (1961) and Aarstad et al. (2010), which describe the onomastic background of historic and modern place names of the county. Only place names with descriptive explanations to its origins and naming practices were collected. If a name did not have a description, it was not used for this thesis. Hence, the total data set compiled to understand the difference between linguistic toponyms in an ethnophysiographic manner was composed of roughly 200 data points.

These place name descriptions embody a conceptualization of landscape in how the land was used and the origins of its name (onomastics). By taking this information, the names can be classified into 8 classes based on the experience of each place. As seen in Table 1, the classes were created specifically for this study based on these definitions of place name and land use.

Where a *geographical* classified name may refer to geographical event (i.e. Lost Lake- named for its hidden location in the summits of the Mission Range) or resemble a recognizable feature (i.e. Mount Jumbo- named for its resemblance to the back of an elephant- see Figure 25).

Figure 25: Oblique image of Mount Jumbo with the outline shape of an elephant. Image taken and outlined by the researcher for this thesis.

It is important to note that these classification methods are not universal across linguistic bodies of place names (Stewart 1954, Brown 2008, and Tent 2015). It was a difficult task to simplify the data in a way to fit 8 classes that were similar in connotations for recording the ethnophysiography of a place between the Indigenous and Euro-American place names. This means that the description between a place and a place name offers variability across languages and to accurately measure the difference between the two languages of toponyms present in the county, a set of classes had to be chosen meticulously. The first step in choosing classes was to be sure that the names and the cultural embodiment of those names would be classified in a holistic and respectful manner for which the language of the name belonged. To do this, classes were created which specifically represent social/cultural events, settlement areas, flora and/or fauna references, accessibility or travel relevant sites, and geographic/geological affiliations. An example of this can be seen with the *human* class where social/cultural gatherings, traditional stories or heritages, and/or relating to specific human involved events (i.e. Council Grove, and Evaro- see Table 4) were grouped to represent one class. An example of the raw Salish Toponym data can be seen in Table 3.

Toponym- English	Toponym- Salish	Classification	Description
Council Grove	C□lmé	Human	Best known for the site where the Hellgate Treaty of 1855 was signed.
Evaro	Snłp□u□(p□□m□)	Human	Denotation of Salish traditional creation story.

Table 4: Two toponym examples from the datasets with their classifications and descriptions.

Fitting the Data to a Power Law

Fitting the datasets to a power law curve is the first transition of qualitative data to quantitative data in this thesis. In linguistic and geographic studies, Zipf's Law has been used to understand the relationship between language and spatial distribution research. This can be seen in Villette and Purves (2018 and 2020) studies by calculating frequencies of individual meaningful elements of toponyms (microtoponyms) to geographic space with an ethnophysiographic model. Further research in linguistics has used this power law by investigating syntax and semantics of a language by Lestrade (2017) and Pantadosi (2014).

Zipf's Law is a power law, which examines the frequency distribution of words in a language where the frequency of a word is inversely proportional to its rank. This means that the more times a word occurs, the lower the rank the word has. This asserts that the most frequently occurring word is equivalent to $\frac{1}{1^b}$, the second most frequently occurring word is equivalent to $\frac{1}{2^b}$, etc… For this thesis, observing whether or not the data have a high goodness of fit to a Zipfian distribution is important in that its fit express if the name was assigned to place intentionally or randomly. There are several ways in which this power law can be calculated; (i) a frequency word calculator like Hermeneutics and through, (ii) a coding software such as the Python PowerLaw package, and/or (iii) Microsoft Excel, which can fit and plot the data to a graph. For this thesis, a Zipf's Law was looked for and plotted in Excel.

Zipf's Law can be ideally expressed in the following equation: $frequency_i = {}^{1}/_{rank_i}$, where *frequency$_i$* is the number of times a word occurs in a corpus of toponyms, and *rank$_i$* is the rank of the word frequencies. This creates a power distribution.

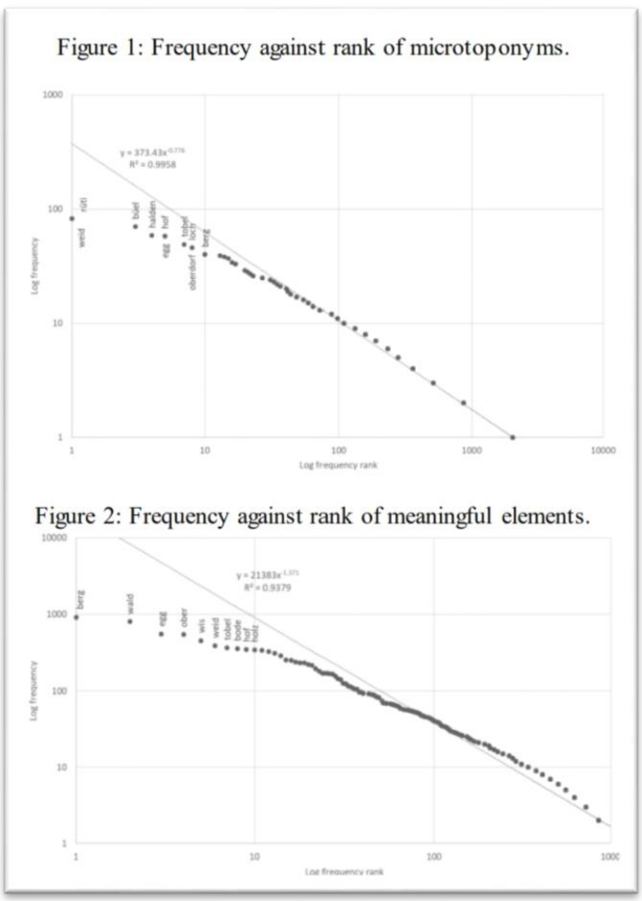

Figure 26: Log-log plots from Villette and Purves (2018 :2) case study on St. Gallen microtoponyms in Switzerland.

In order to determine if the modeled data is a valid form of Zipf's Law the data needs to be rescaled from a power law curve to a log-log plot by taking the logarithm of both sides of the unideal Zipf's Law equation which is $f(r) = {}^{a}/_{r^{\mathrm{b}}}$ where *a* is a constant and an ideal Zipf's frequency will have a *b*≈ 1. Taking the logarithm will result in the equation: $\log(f) = \log(\alpha) - b * \log(r)$. This manipulates the unideal Zipf's Law equation to take the form of $y = mx + b$ where the slope is (-*b*). To plot these data, we will take the $\log(r)$ and the $\log(f)$ and graph it on a log-log plot as seen in Figure 37. Since we know an ideal Zipfian distribution has a slope of -1, then the closer the slope of the log-log plot is to -1, the more correct it is to assume that the data is modeled using Zipf's Law.

Measuring the Ethnophysiography of Missoula

Figure 27: An example of the PLSS Township-Range vector layer from the Montana GIS Clearinghouse.

By taking the collected datasets of points with descriptive information and adding them to a map in GIS, the model to measure ethnophysiography is built. Before building this model, a grid needs to be applied to the area for which the points exist spatially. This is because the points are displayed in clusters that primarily reside within the boundaries of present-day Missoula County, and the grid offers a smooth interpolation between points. However, due to the issues of boundaries mentioned in Chapter One, many of the points lay outside of this boundary and do occur in random patterns naturally. To accurately interpolate the conceptualization of place between these points according to the assigned classifications, the region of the existing points needs to be structured. A grid will structure this information for a smooth interpolative analysis of the surface area between the points to illustrate the connection of the points and the connection to the landscape. Since a cadastral system of landscape exists for property ownership and survey, the grid is influenced by the Public Land Survey System's (PLSS) Township model (refer to Figure

26). The Create Fishnet geoprocessing tool creates a grid roughly following the Township and Ranges of Missoula County and its surrounding areas as seen in the Figure 27.

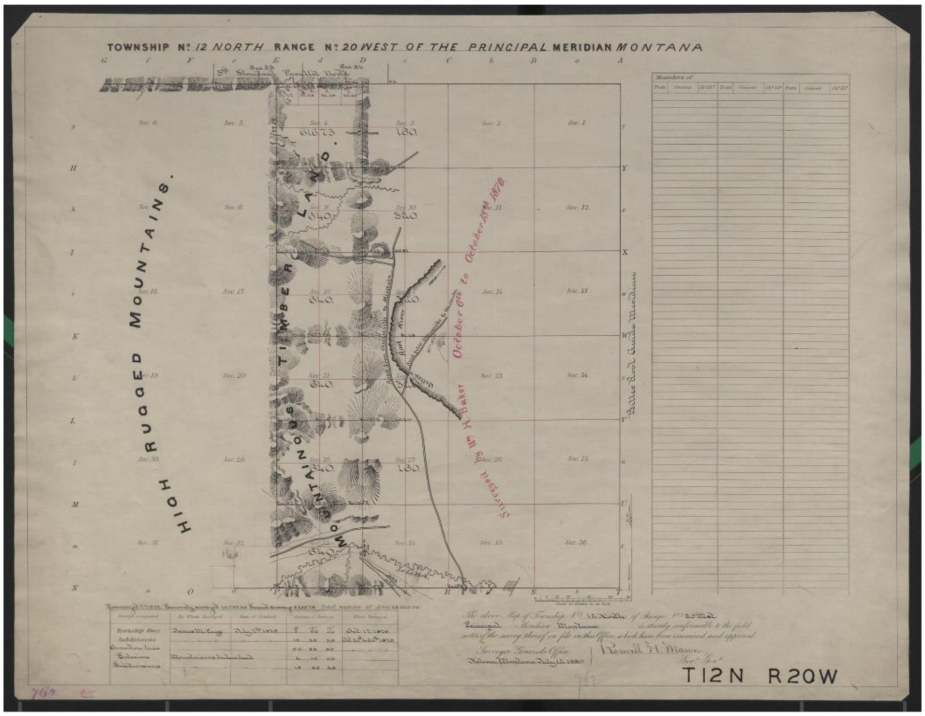

Figure 28: General Land Office (GLO) survey from the 1870s of Township 12 North, Range 20 West. Present-day Lolo, MT is in T12N R20W, Section 35 (Bottom row 2nd from the right). Survey downloaded from the US Department of the Interior- GLO Records. Surveyor- James M. Page (glorecords.blm.gov).

Two layers are created from running this tool. The first is the actual polygon units that make up the frame and the 484 cells (units) inside the frame. The second is the centroid per cell to attach the toponym or data points to run the spatial analysis. (Figure 27) Since there are 8 classes and we want to view the difference between conceptualized land use/environment of each class and language, eight new attribute fields need to be made in the attribute table of the centroid layer. This needs to be done for each layer of toponym data. So, two layers of the centroid information exist- one for the Indigenous place names and one for the Euro-American place names. After running several queries to enter the data per class per centroid, each centroid should hold a quantity of how many points exist per unit per class. This means that if one unit contained three points where two of those points were *geographical* classes and one point was *animal* class, then 2 points would be recorded for the g*eographical* attribute field, one point recorded for the a*nimal* attribute field, and 0 points recorded for the remaining 6 attribute fields (refer to Table 5). The reason behind using count data rather than the numerical labels assigned is because we want to keep the social integrity of the names nonhierarchical while still measuring the spatial attributes in an empirical and quantifiable structure. This is the second occurrence of data transitioning from qualitative to quantitative expression for close examination and accuracy.

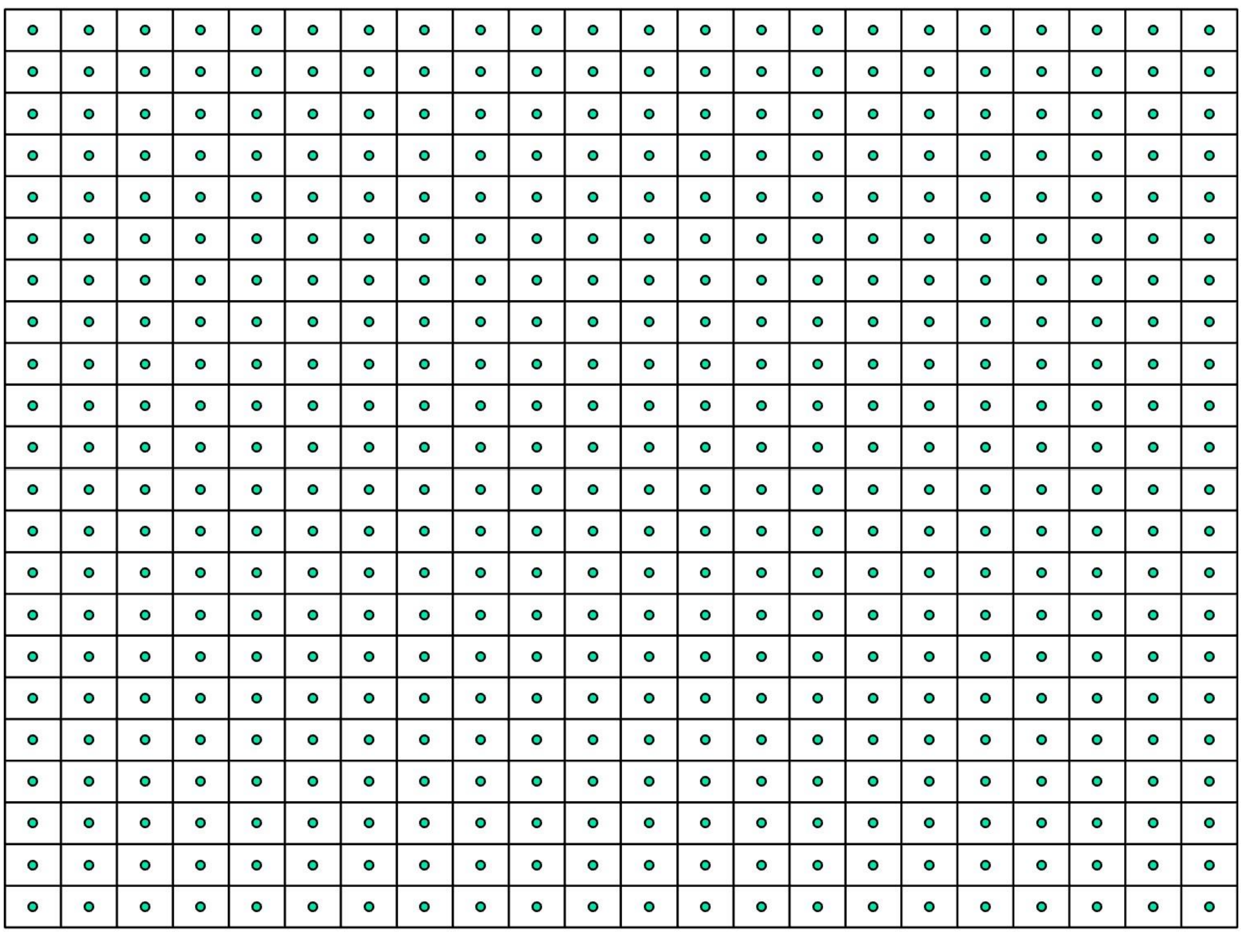

Figure 29: A fishnet grid and centroid points roughly following the PLSS Township Survey over Missoula County and Surrounding areas.

LAT	LONG	PLACE_NAME	OTHER_NAMES	TRANSLATI	PRESENT_L	COUNTY	CLASS	TRANSLATI	ELEVATION	GNIS_ID	USGS_CLAS	L/	DESCRIPTION
46.99411	-114.063	Sn??ú	Sn?púp??	Place Wher	Base of Eva	Missoula	Origin	Geological	3960	1781325	Locale		Name among oldes in langua
47.18118	-114.098	C?x?tpmn?w?e?	C?x?tpmn?w?e?(x?)	Null	Jocko Hollo	Lake	Origin	Null	2986	1797059	Locale		Stomach of the Na?isqe?lix? r
47.01492	-114.23	Qw?e?		Refering to	Frenchtowr	Missoula	Geological	Geological	3045	1781295	Locale		Name is suggested to refer to
46.88166	-114.116	?lmé		Tree Limb (	Near Counc	Missoula	Tradition	Vegitation	3084	794298	Locale		Traditional Salish camp; site c
46.92647	-113.932	N??ay	N??ayc?stm	Place of the	Rattlesnake	Missoula	Animal	Animal	3169	2411124	Civil		Refered to ajor camp; catchin
46.85226	-113.963	Eslq??		It's a Moun	Mount Sen	Missoula	Geological	Geological	5154	790231	Summit		Vantage point to view down t
46.87923	-113.956	Nm?q??e?		Humped M	Base of Mo	Missoula	Camp	Geological	4770	785601	Summit		Campsite now partly buried u
46.84694	-114.016	Snac??q?ey?mi?n		Place of the	Around Mis	Missoula	Camp	Human	3189	1781174	Park		Used as a campsite; named fo
46.87083	-113.889	N?ayc?stm		Place of La	Clark Fork a	Missoula	Animal	Animal	3314	1781318	Locale		Where large bull trout could l
46.78929	-113.927	Síoʔté		Valley Whe	Pattee Can	Missoula	Access	Geological	3264	788694	Valley		Camp for colleting bitterroot;
46.87111	-113.824	?aayc?stm	??íc?stm	Place of Bu	Bonner	Missoula	Access	Animal	3314	1781318	Locale		Major junction of trail system
46.52326	-112.812	Snxwqwpu?saqs		Junction of	Garrison Ju	Powell	Acceess	Access	4373	1803402	Locale		[Historic] Garrison named for
46.54469	-112.08	??mlš?		Cottonwoo	Helena are	Lewis and (	Null	Vegitation	3999	2410734	Civil		Headquarters of major Salishi

Table 5: Attribute table displaying count points for each toponymic classification.

Once the data is attached to the grid, I have two grid layers with nine[3] attribute fields with one grid for each toponym dataset. The minus tool is applied to measure the observable change in ethnophysiography between linguistic groups and land cover. This process needs to be done nine times for each data set because we want to see the conceptualized difference in landscape of each class and the total number of classes per unit per data set. The most efficient method in proceeding with this is by creating a model with ArcGIS Pro Model Builder. Such a model can be built to interpolate data and calculate for ethnophysiography and any changes therein then display the total outputs with the click of one button as seen in Figure 30.

[3] One attribute field for each toponym class and one denoting the presents of a point within a cell with a 'Yes' or 'No'.

Figure 30: Ethnophysiographic Geographic Information Model.

There are two main surface analysis tools that are used for this analysis to test **Hypothesis 2-** the IDW and Natural Neighbor (NN) geoprocessing tools. Both of these tools are surface interpolation geoprocessing tools that produce raster outputs. This means that from the points of the datasets, the surface of the grided area can be interpolated to produce a layer that shows the distribution of these classes between the body of points. IDW "assumes that the variable being mapped decreases in influence with distance from its sampled location" (ESRI IDW Resources). For this thesis, IDW is used to represent the count values of each toponym classification where the influence of conceptualized place differs between points of each class. Once this raster output is produced per toponymic dataset, each class layer of each toponym dataset can be taken to visually see the difference of conceptualization of place and the distribution of these classes between points over Missoula County. IDW utilizes an inverse weighted technique to understand the distance related to interpolated isotropic values between points. This means it mathematically calculates the inverse relationship between densely clustered points to produce a multidirectional uniformity of data for a smooth raster interpretation. An example of an IDW output raster can be seen in Figure 31.

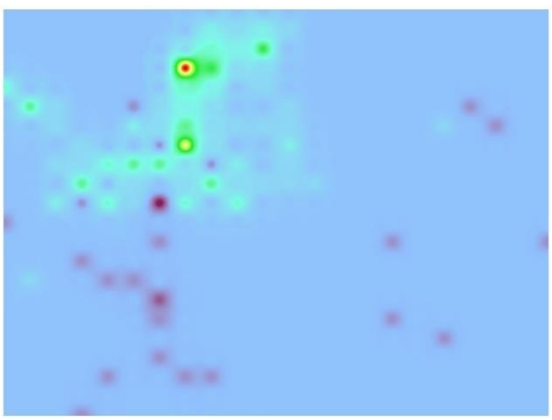

Figure 31 (Left): An example image of an Inverse Distance Weighted interpolation between the Salish toponym points with a Stretched symbology and a Minimum Maximum stretch type.

On the contrary, the Natural Neighbor interpolation tool is an algorithm that applies weighted variables to geographical surfaces based on a set of point values and interprets the ideal subset between the points. Unlike the IDW where the interpolation is based on distance, the interpolated information between points in an NN is respectively based on intersecting point values. Given that one tool is mathematically modeled to interpret the relationship between points (IDW) and the other is algorithmically modeled to interpret spatial surface between points (NN), the IDW tool is used to understand the ethnophysiography between toponymic classification layers and the NN tool is used to cross-reference land cover layers with the interpolated toponymic outputs and compute the change (if any) between land cover layers.

Land Cover Extraction, Simplification, and Development

With IDW being the appropriate tool to calculate the ethnophysiography of toponyms, the Natural Neighbor is used for the land cover portion of this research since it allows for the data to be simplified and offers a method to build an early land cover layer of the protohistoric era based on toponymic geographic land use descriptions. This interpolative tool is used on the raw data rather than count values. This is because the land cover data is assigned Ecological System Land Feature (ESLF) codes and dose not embody any direct cultural information. Unlike other interpolation tools such as IDW, Spline, and Kriging, the Natural Neighbor tool does not interpolate spatial information between the points using strict mathematical functions. Instead, it holds the input values of the points and creates a range of data that can easily be reclassified to show the areas that are predicted to follow the Ecological System class values as seen in Table 6. This denotes a natural land cover layer for which toponym points can be overlayed and compared against the hand created protohistoric land cover layer and a modern land cover layer used in this research.

LAND COVER	*LAND COVER TYPES*	*VALUE*
Alpine, Snow, and Ice	Contains vegetated landscapes above the treeline, Alpine Meadows (8100), Snowfields or Ice (9100)	1
Forested Lands	Contains forest cover greater than 10%	2
Grasslands	Contains landscapes where 15% or less of herbaceous cover, 15% or less of shrub cover, and 10% or less of forested cover.	3
Shrublands	Contains landscapes where 15% or less of shrub cover and 10% or less of forested cover.	4
Barren Lands	Contains landscapes are less than 10% forested cover, less than 10% of shrub cover, and less than 10% of herbaceous cover	5
Recently Disturbed	Landscape that has been modified due to forest fire, wilderness management, urban or human terrain influences.	6

Open Water	Landscapes pertaining to areas of open water (i.e. lakes and stream systems) and other sources of waters (i.e. hot springs, watersheds, swamp, sloughs or estuary environments).	7
Human Land Use	Urban and agricultural landscapes such as developed lands, and dry and irrigated agricultural land systems.	8
No Data	Areas where no data is available	9

Table 6: Land Cover Classifications and Classification Definitions based on Montana Natural Heritage Program (MTNHP) (2017).

Based on a 1998 Montana Land Cover Atlas by Fisher et al. (1997), there are eight primary land cover classifications known as Ecological Systems for which sub-system classes are organized under. Since the toponymic data sets were inspired by linguistic and land cover classification methodologies as mentioned earlier in this chapter, the classes applied to the land cover were unaltered and based on the sub-system ESLF codes, which follow the descriptive methods of the atlas. A dataset of these attributes is shown in Table 7. This means there are eight land cover classifications for which the land cover was modeled against the toponymic interpolative raster outputs which is illustrated in Figure 30. From the descriptive information of place names and land use of sites described in the ethnographic accounts by Malouf (1952), Indigenous texts on place by Salish-Pend d'Oreille Cultural Committee (2005[2018]), and vegetative descriptions of Indigenous TEK by Bear Don't Walk (2019), Habeck (1967), and Hart (1976), a rough sketch of early land cover (based on the protohistoric time frame) can be assumed (reference Figure 31).

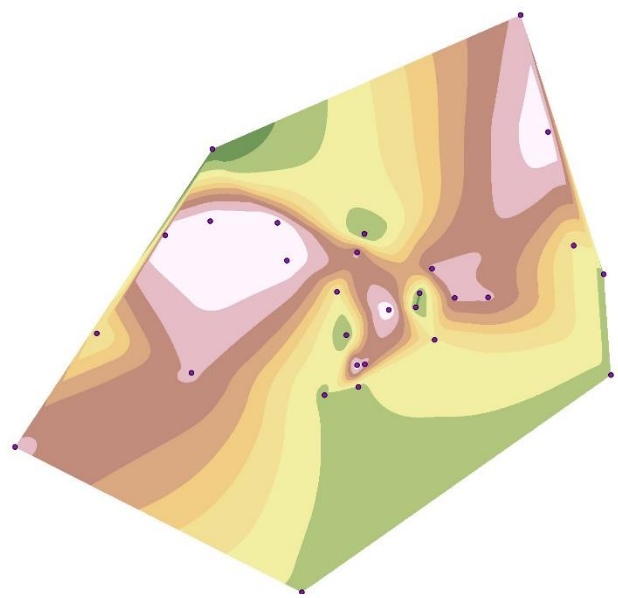

Figure 32: A raw Natural Neighbor interpolative raster layer from the ESLF codes of the Salish toponymic dataset.

DESCRIPTION	C	E	E	ESLF_2016_Values	ESLF_Desc_Values	LC_ValueClasses16	LC_ValueClassesDE	IndividualLCValues
Name among oldes in...	8	4...	4...	4232	4232	2	2	2
High point or place to...	9	28	4...	28	4232	8	2	2
Campsite now partly b...	11	22	4...	22	4232	8	2	2
Named for the fir tree...	3	11	4...	11	4243	7	2	2
Most important camas...	3	4...	2...	4232	7118	2	3	3
Named for the the Re...	3	4...	7...	4232	7118	2	3	3
Named for the sound...	9	7...	7...	7112	7113	3	3	3
Used as a site for hoo...	11	4...	7...	4243	7113	2	3	3
Small clump of trees;...	11	28	7...	28	7112	8	3	3
Traditional Salish cam...	1	81	5...	81	5263	8	4	4
Camp for colleting bitt...	7	5...	5...	5312	5209	4	4	4

Table 7: Salish land cover ESLF codes and Ecological Systems classes.

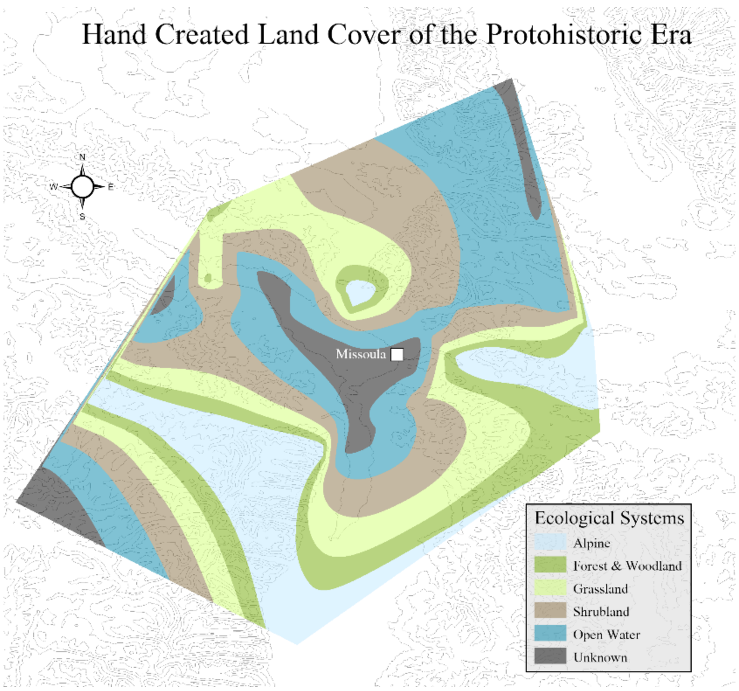

Figure 33: (Left) Interpolated protohistoric landcover of Missoula County from descriptive land use information from toponymic source materials.

Once the initial Natural Neighbor layers are computed, two tools can be used to understand the difference in land cover layers. The first is the Compute Change Raster tool which takes two raster layers and computes the difference between them in one of three ways- taking the (i) difference- subtracting one data set from another mathematically, the (ii) relative difference- subtracting the datasets while keeping the pixel integrity of each layer, and (iii) categorical- where the outputs show every class transition. For this portion of the research analysis, the relative difference option is used here because the land cover information has been extracted from the ESLF codes (codes used for the purpose of the state of Montana to classify land cover on a sub-systems scale) by hand and assigned to the land cover classes in the attribute table. This keeps the integrity of the original 30-meter pixel 2016 land cover layer. A diagram illustrating how this tool works can be seen in Figure 31. These output values denote a positive, negative, or no change between the initial raster layers. These positive and negative values are where changes occur in the direction from the earliest land cover layer to the modern land cover layer. The further away from 0, the more drastically the land cover changes between the two raster layers. The reason for having negative values is to denote the direction in which a change occurred (i.e. a change from Ecological System 2 (Forested) to 8 (Human Land Use)). The direct ESLF codes were not used for this calculation because the codes are not valued hierarchically and thus would not allow for a smooth reclassification of information back into ordinal data. Instead, they were labeled numerically on a scale between 1 and 8.

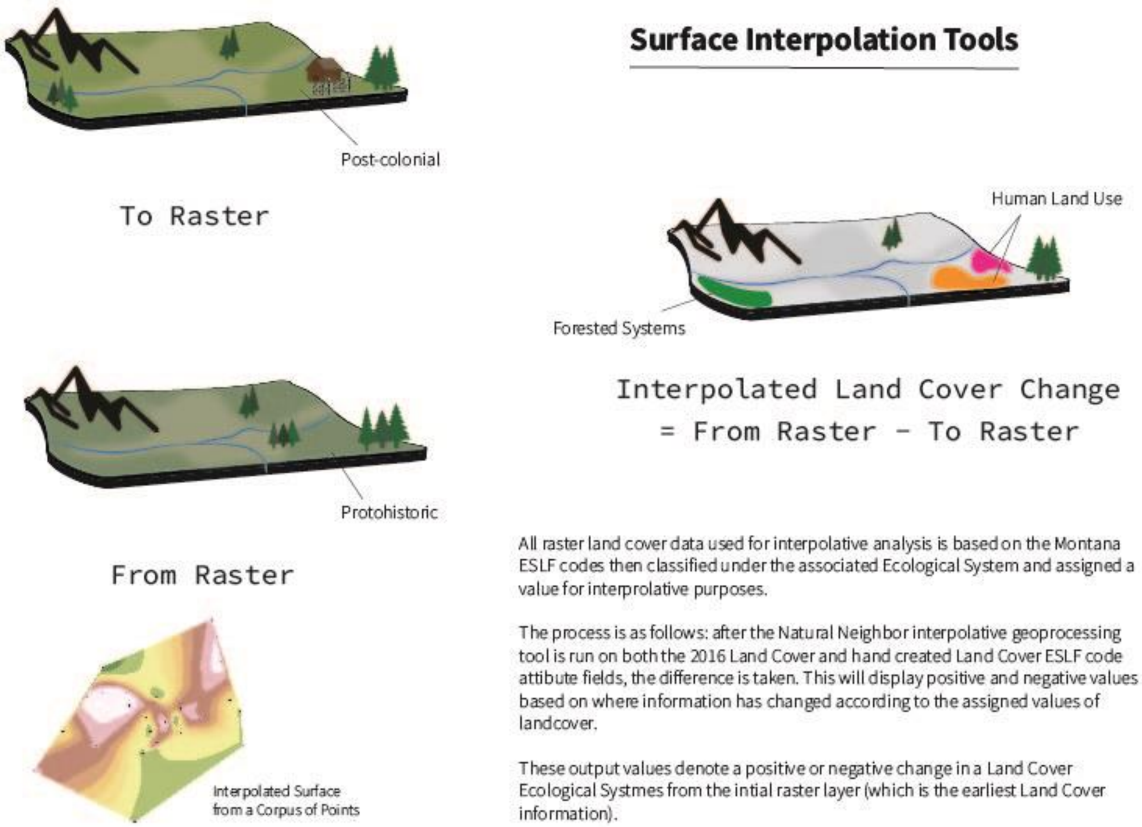

Figure 34: Example of how the surface interpolation tools are used to understand the difference between land cover(s) and toponym ethnophysiographies.

The second tool is the Minus tool, which calculates the difference between two raster layers. Though similar to the Compute Change Raster tool, the Minus tool can only measure the difference of two rasters. This tool is used in calculating the difference between the raw toponymic datasets to have a comparison and to test why the grid is necessary to calculating the ethnophysiographic difference between toponymic layers. As can be seen in Figure 33 compared to Figure 34, the raw dataset of toponymic class values does not clearly differentiate between each class of toponymic descriptions where the gridded dataset allows for a direct contrast for each class (refer to Figure 31).

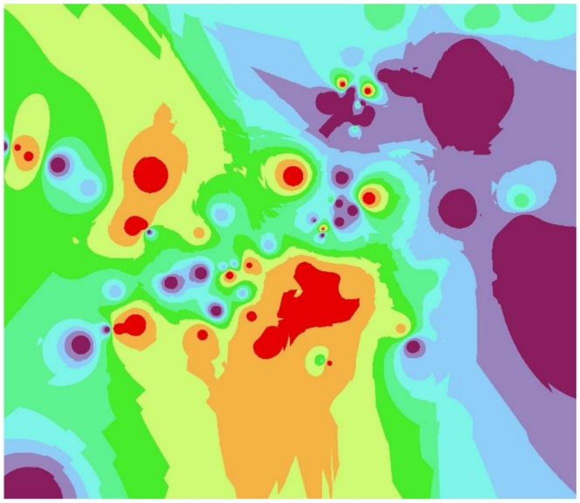

Figure 35: IDW of raw toponymic data classification values where each color represents a unique class (i.e. Animal or Camp/Urban).

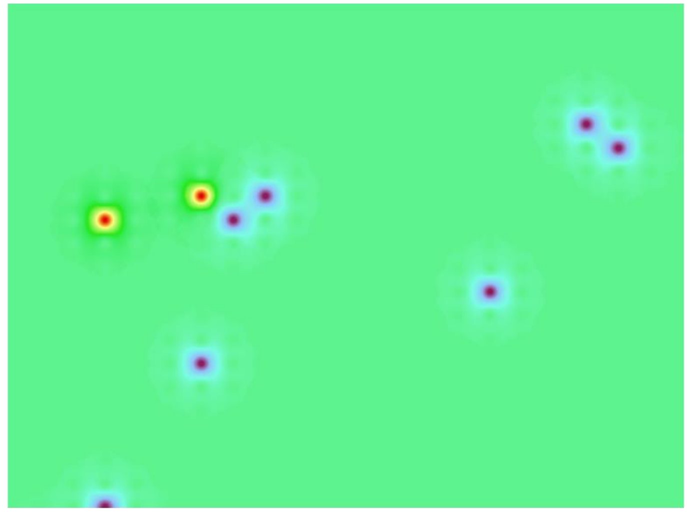

Figure 36: IDW of count values from a gridded toponym dataset representing the difference between the count values of the Salish and English geographic toponym classifications for each unit where a geographical classified toponym occurs.

This is important because this research is interested in understanding the conceptualization of place according to their place names and whether or not a difference occurs between toponyms of different languages. By attributing this information to a grid, this change can be seen and will show ethnophysiographic change in an organized manner (refer to Figure 34). The same output logic in understanding the positive and negative values applies to these output features as well.

There are three general steps to analyzing the ethnophysiography of place names, comparing it to land cover, and calculating the change: (i) individually interpolate between toponym classes on a grid of each toponym dataset, (ii) interpolate and compare land cover Ecological Systems by their class values from raw data sets, and (ii) compute the change between (i) and (ii) using one of two tools. Model Builder is an efficient way to process this information and create the necessary outputs for review and to determine the results of this thesis. Using Model Builder, by inputting the Euro-American IDW raster toponym layer as input value 2 and Indigenous IDW raster toponym layer as input value 1 of each individual class and subtracting each layer using the Minus mathematical tool in ArcGIS Pro, nine summarizing raster layers of interpolated isotropic data should be outputted. These summarized outputs of toponymic raster layers are the ethnophysiographic differences that are expressed according to secondary information collection of place name and place conceptualizations. By cross-referencing the land cover information with the toponym information, we can see the patterns of how landscape conceptualizations interact with early and modern land covers. This means that two models had to be built, which can be seen in Figures 33 and 34.

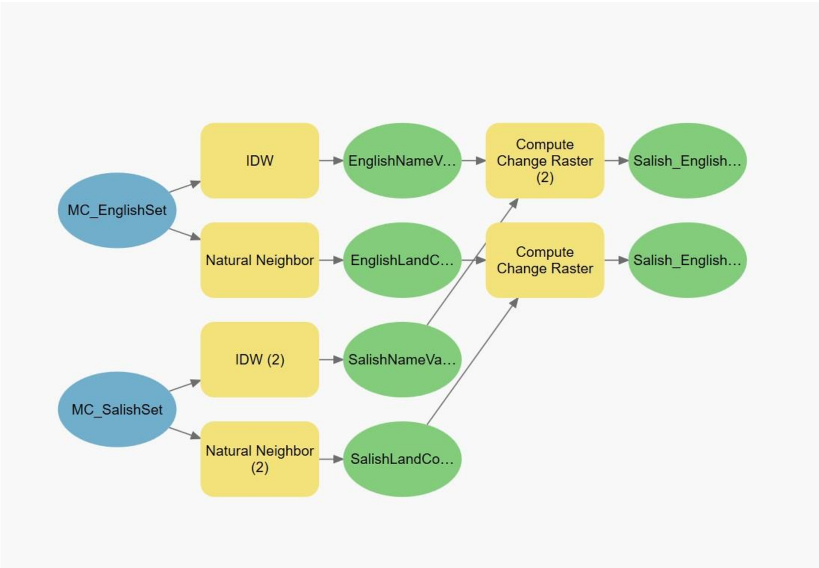

Figure 37: Land cover comparative model testing the output raster's for the best tool use.

Conclusion

This chapter has explained the methodologies used to measure and analyze the ethnophysiographic data of this thesis. Collection of toponym descriptions and spatial information was gathered via archival and research case studies. Methodologies from Villette and Purves (2018), Bobbitt (2015), Teerarojanarat and Tingsabadh (2011), Omundson (1961), O'Connor and Kroefges (2008), Martina (2017), and more were referenced to develop this methodology and investigate the relationship of toponym and landscape in Missoula County.

Chapter Five: Results

"Existing GIS ecosystems need to be designed in ways that support Indigenous data sovereignty and visibility-for the benefit of all."

-(Leonard 2021)

Introduction

This research investigates an ethnophysiographic relationship between Missoula County toponyms and land use/cover. The methods used to collect and analyze the data followed an ethnophysiographic model of secondary resource collection, which was transformed into quantitative data and used for geographic and statistical measurement in GIS and Excel. Following workflows by Omundson (1961), Fuchs (2015), O'Connor and Kroefges (2008), Bobbitt (2015) and others, toponyms and their descriptions were collected and classified to measure the (i) ethnophysiography of Salish and English place names of Missoula County as they relate to landscape and (ii) understand how sites are named (i.e. intentionally or other) by analyzing the data to see if it is Zipfian distributed. However, due to the lack of ethnographic initiative, the data collected is a sample of the total toponymic information available according to the GNIS database, GLO historic surveys, and the Plateau People's Web Portal. Although the datasets are small in nature, this research demonstrates that an ethnophysiography does exist in Missoula County and expresses a 15% difference between toponyms of different languages. Furthermore, according to the toponymic datasets, a Zipfian distribution does not occur, which suggests that the relationship between place names and landscape is strongly based on or connected to the ways in which the landscape is utilized and/or land cover features. Moreover, compared to the hand collected datasets of toponyms, the unaltered datasets of names downloaded directly from the Montana GIS Clearinghouse exhibit a slope closer to the Zipfian ideal of (-1).

A Zipfian Distribution

When analyzing the data for a Zipfian distribution, three datasets were used. Two were the descriptive datasets (or the focus points) of this thesis while the third was a raw dataset (taken directly from the GNIS database) and was used as the control dataset to ensure the results were unbiased. The frequency vs rank power law distributions were graphed from these datasets as shown in Tables 8, 9, and 10. A power law trend line was placed on these graphs to see how accurately the trendline described the data according to its R^2 value. It can be seen that the control dataset, Table 8, is closest to the power law distribution with an R^2 value of 0.92 (see Figure 38). This means that the trendline describes nearly 90% of the data of this dataset. The Indigenous toponymic dataset was the second closest with R^2=0.90 (Figure 39) followed by the third Euro-American toponym dataset with R^2=0.75 (Figure 40).

RANK	FREQUENCY	WORD	Log(r)	Log(f)	Log(a)	Log10(r)	Log10(f)
1	329	creek	0	2.517196	2.517196	0	2.517196
2	108	lake	0.30103	2.033424	2.334454	0.30103	2.033424
3	67	gulch	0.477121	1.826075	2.303196	0.477121	1.826075
4	57	trail	0.60206	1.755875	2.357935	0.60206	1.755875
5	47	fork	0.69897	1.672098	2.371068	0.69897	1.672098
6	37	ski	0.778151	1.568202	2.346353	0.778151	1.568202
7	31	peak	0.845098	1.491362	2.33646	0.845098	1.491362
8	31	mountain	0.90309	1.491362	2.394452	0.90309	1.491362
9	20	point	0.954243	1.30103	2.255273	0.954243	1.30103
10	16	west	1	1.20412	2.20412	1	1.20412
11	15	north	1.041393	1.176091	2.217484	1.041393	1.176091
12	14	east	1.079181	1.146128	2.225309	1.079181	1.146128
13	12	little	1.113943	1.079181	2.193125	1.113943	1.079181
14	11	spring	1.146128	1.041393	2.187521	1.146128	1.041393
15	11	south	1.176091	1.041393	2.217484	1.176091	1.041393
16	10	elk	1.20412	1	2.20412	1.20412	1
17	10	bear	1.230449	1	2.230449	1.230449	1
18	9	upper	1.255273	0.954243	2.209515	1.255273	0.954243
19	9	lost	1.278754	0.954243	2.232996	1.278754	0.954243

Table 8 (Left): The control dataset- modern Missoula County place names downloaded from the Montana GIS Clearinghouse via the GNIS database. This dataset is used to calculate for a Zipfian distribution and to ensure unbiases.

RANK	COUNT	WORD	LogRANK	LogCOUNT	LogA
1	11	place	0	1.041393	1.041393
2	9	of	0.30103	0.954243	1.255273
3	8	the	0.477121	0.90309	1.380211
4	8	null	0.60206	0.90309	1.50515
5	7	where	0.69897	0.845098	1.544068
6	4	trees	0.778151	0.60206	1.380211
7	4	something	0.845098	0.60206	1.447158
8	4	it	0.90309	0.60206	1.50515
9	4	has	0.954243	0.60206	1.556303
10	4	a	1	0.60206	1.60206
11	3	water	1.041393	0.477121	1.518514
12	3	two	1.079181	0.477121	1.556303
13	3	trout	1.113943	0.477121	1.591065
14	3	to	1.146128	0.477121	1.623249
15	3	on	1.176091	0.477121	1.653213
16	3	is	1.20412	0.477121	1.681241
17	3	ground	1.230449	0.477121	1.70757
18	3	bull	1.255273	0.477121	1.732394
19	2	waters	1.278754	0.30103	1.579784

Table 9: Salish toponym dataset created by the researcher for a Zipfian distribution calculation.

RANK	FREQUENC	WORD	LOG(R)	LOG(F)	LOG(A)
1	49	creek	0	1.690196	1.690196
2	32	lake	0.30103	1.50515	1.80618
3	12	gulch	0.477121	1.079181	1.556303
4	11	peak	0.60206	1.041393	1.643453
5	7	river	0.69897	0.845098	1.544068
6	5	mountain	0.778151	0.69897	1.477121
7	4	jocko	0.845098	0.60206	1.447158
8	3	point	0.90309	0.477121	1.380211
9	3	lakes	0.954243	0.477121	1.431364
10	3	horse	1	0.477121	1.477121
11	3	glacier	1.041393	0.477121	1.518514
12	3	falls	1.079181	0.477121	1.556303
13	3	big	1.113943	0.477121	1.591065
14	2	sapphire	1.146128	0.30103	1.447158
15	2	salmon	1.176091	0.30103	1.477121
16	2	park	1.20412	0.30103	1.50515
17	2	mount	1.230449	0.30103	1.531479
18	2	meadow	1.255273	0.30103	1.556303
19	2	lolo	1.278754	0.30103	1.579784
20	2	lick	1.30103	0.30103	1.60206
21	2	hill	1.322219	0.30103	1.623249
22	2	high	1.342423	0.30103	1.643453
23	2	fork	1.361728	0.30103	1.662758
24	2	crystal	1.380211	0.30103	1.681241

Table 10: English toponym dataset created by the researcher for a Zipfian distribution calculation.

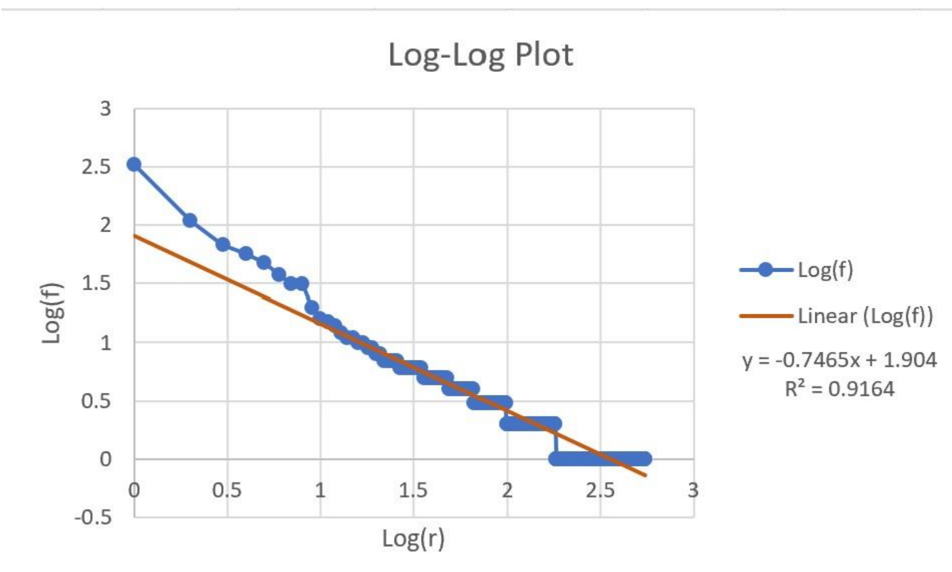

Figure 38: Log-log plot of the 2019 GNIS toponym dataset (control dataset) showing a slope of -0.75 with an R^2=0.92.

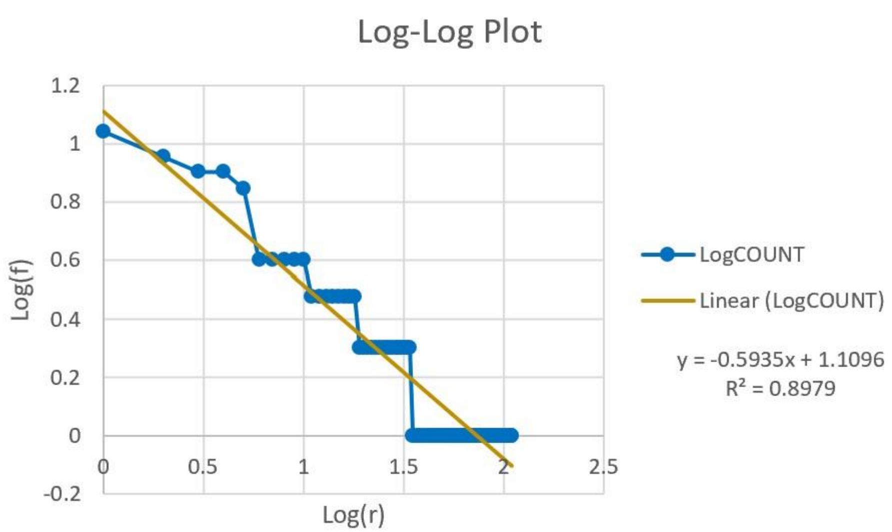

Figure 39: Log-log plot of the Salish toponym dataset showing a slope of (-0.6) with an R^2=0.9.

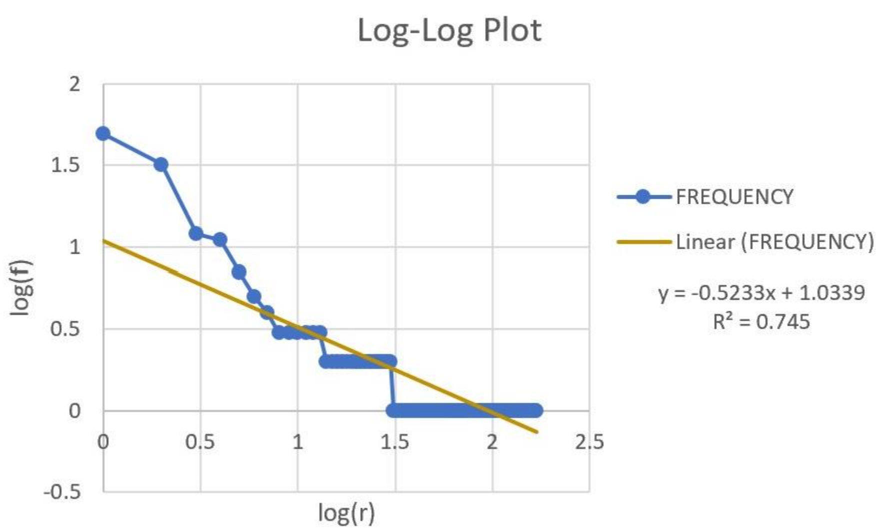

Figure 40: Log-log plot of the English toponym dataset showing a slope of -0.52 with an R^2=0.75.

These results led me to believe that the constant dataset will most likely have the closest slope to -1 when plotting on a log-log graph because of the power law trendline as seen in Figure 41.

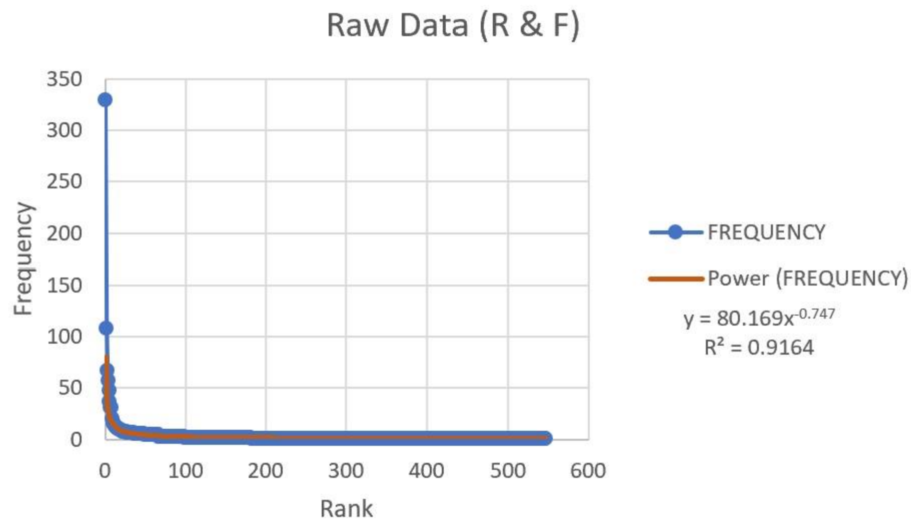

Figure 41: A power law graph with a power law trendline based on the raw data of the 2019 GNIS toponym dataset.

In order to test this hypothesis, the data were plotted on a log-log graph and then a linear trendline was added with its corresponding equation. Since an ideal Zipfian distribution will have a log-log plot with a linear trendline that has a slope of -1, the log-log graphs of each dataset were tested against this notion to determine whether or not the data could be described by a Zipf's Law (see Figures 38-40). However, it can be seen that the focus datasets display a slope of -0.60 and -0.52, which do not constitute or describe a Zipfian distribution. This suggests that the bulk of the place names are not selected randomly based on descriptive environments but are intentional in nature according to how the landscape was and is used, confirming **H1** *The relationship expressed between toponyms of diverse languages and landscape should not statistically produce a Zipfian Distribution because places are named intentionally.*

Ethnophysiography

Through place, emotional connections are embodied with cultural, linguistic, and other values or meanings via human cognition or thought (Lengen and Kistemann 2012; Mark et al.

2011; and Tent 2015). The experience of landscape is conceptualized through a number of phenomena including traditional knowledge, linguistic discourse, and interpretations of cultural heritage (Basso 1996). These interactions with landscape are what initiate a bond to the environment and build perceptions of the world (Daurio 2009). An ethnophysiography attempts to understand these phenomenological connections via cross-disciplinary multitudes and technologies (Turk 2003). Thus, one such course of action to understand perception is through toponymic descriptions of place. This research has focused on the collection of information where descriptive contexts represent the perceptions and experiences of its identifying spatial area or place.

The resulting ethnophysiography per individual classification of toponyms has been calculated in GIS via an IDW interpolative spatial analysis. As discussed in Chapter Four and roughly following the PLSS of Townships, the number of classes per unit of the grid were assigned to the centroid information layer and processed eight distinct times for all eight categories of each toponym dataset. The following Figures (42-49) are the outputs of the spatial interpolations and the percentages of occurrence per class per layer.

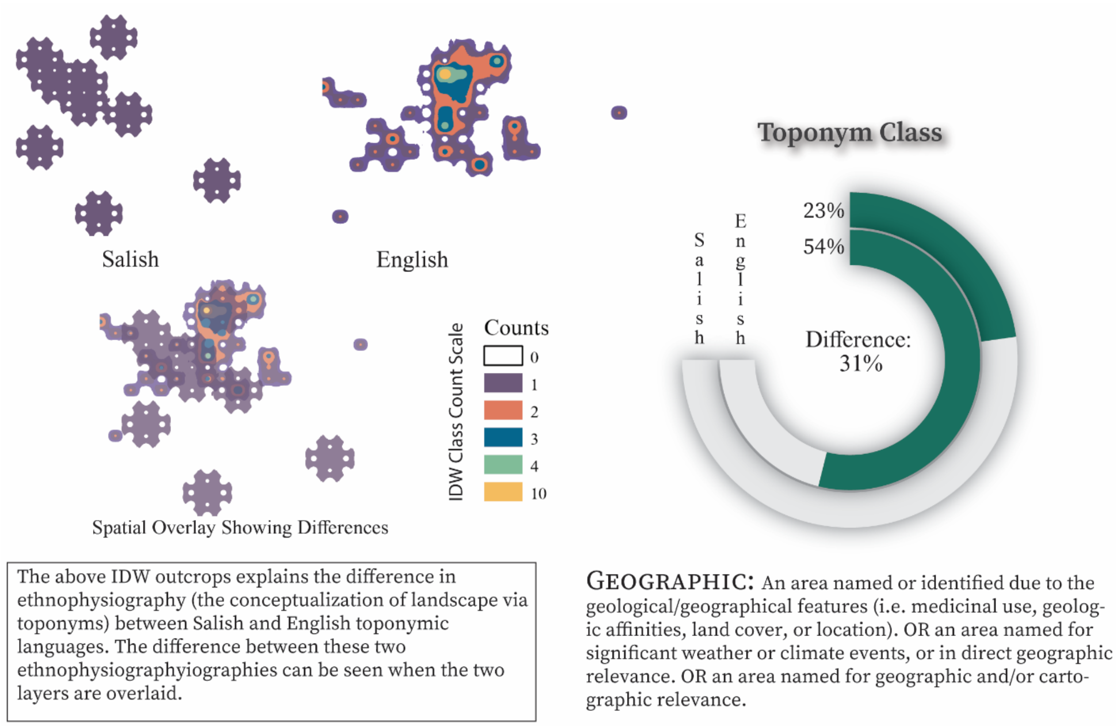

Figure 42: This graphic shows that for the Geographic toponym class, 54% of English points have descriptions that refer to geologic features, spatial reference or other compared to 23% of Salish points. This shows a difference of 31%.

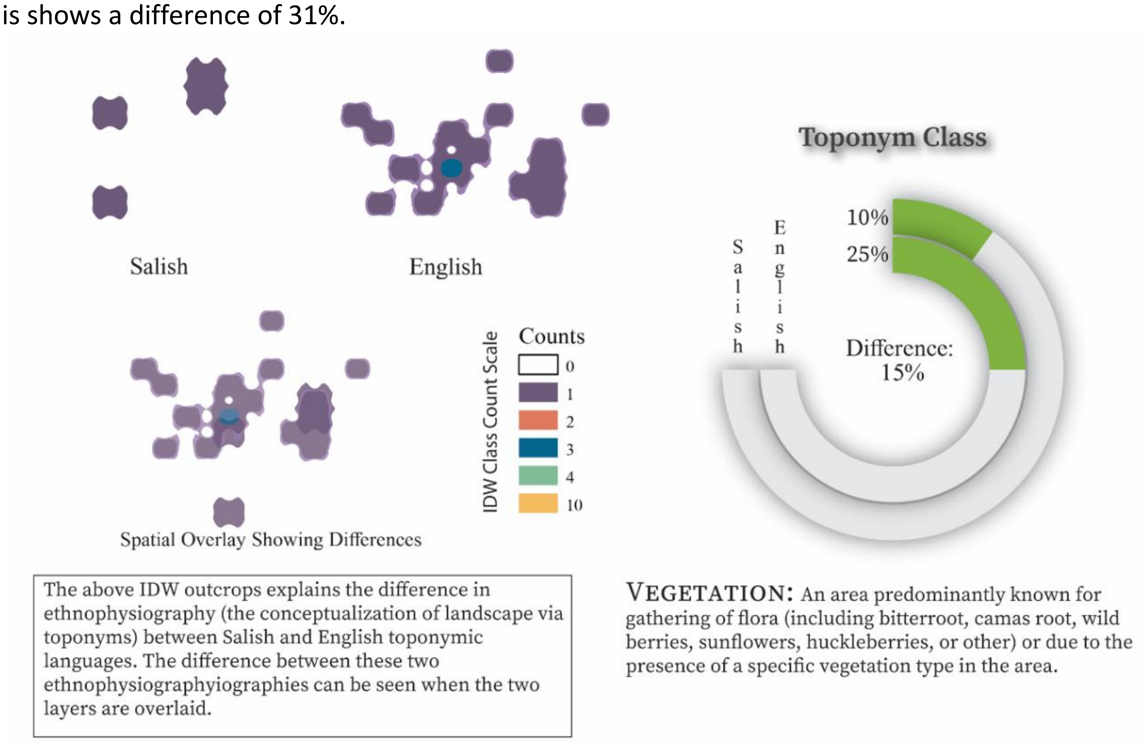

Figure 43: This graphic shows that for the Vegetation toponym class, 25% of English points have descriptions that refer to floral features, vegetative collection, or other compared to 10% of Salish points. This shows a difference of 15%.

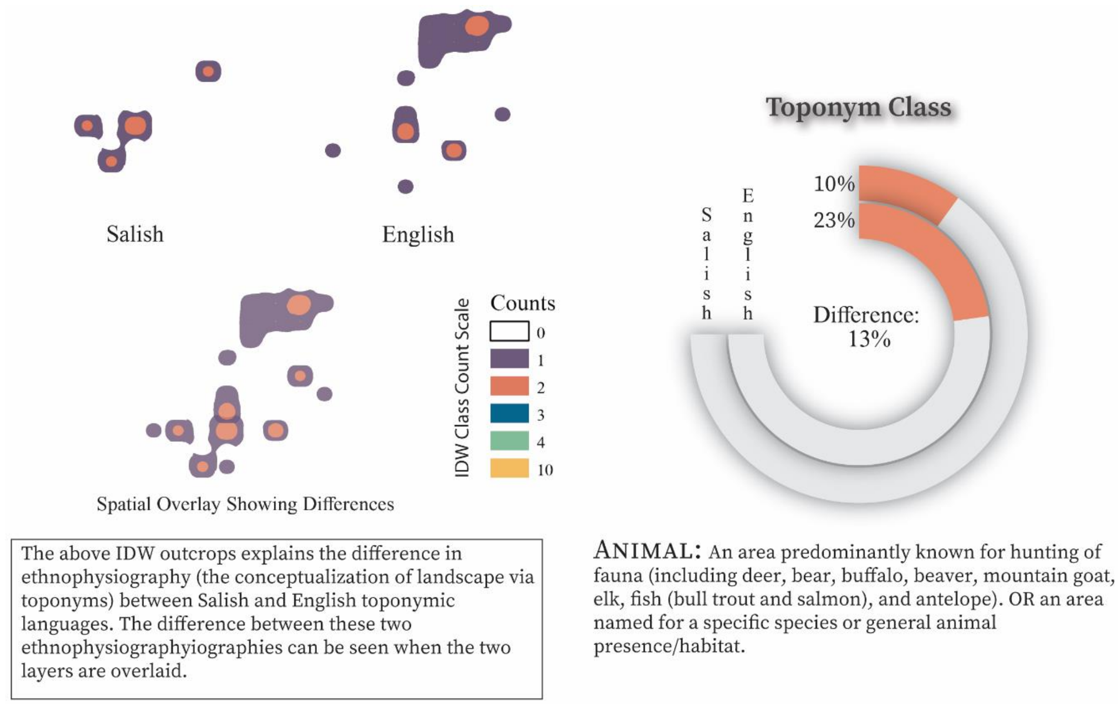

Figure 44: This graphic shows that for the Animal toponym class, 23% of English points have descriptions that refer to animal habitats, fauna hunting, or other compared to 10% of Salish points. This shows a difference of 13%

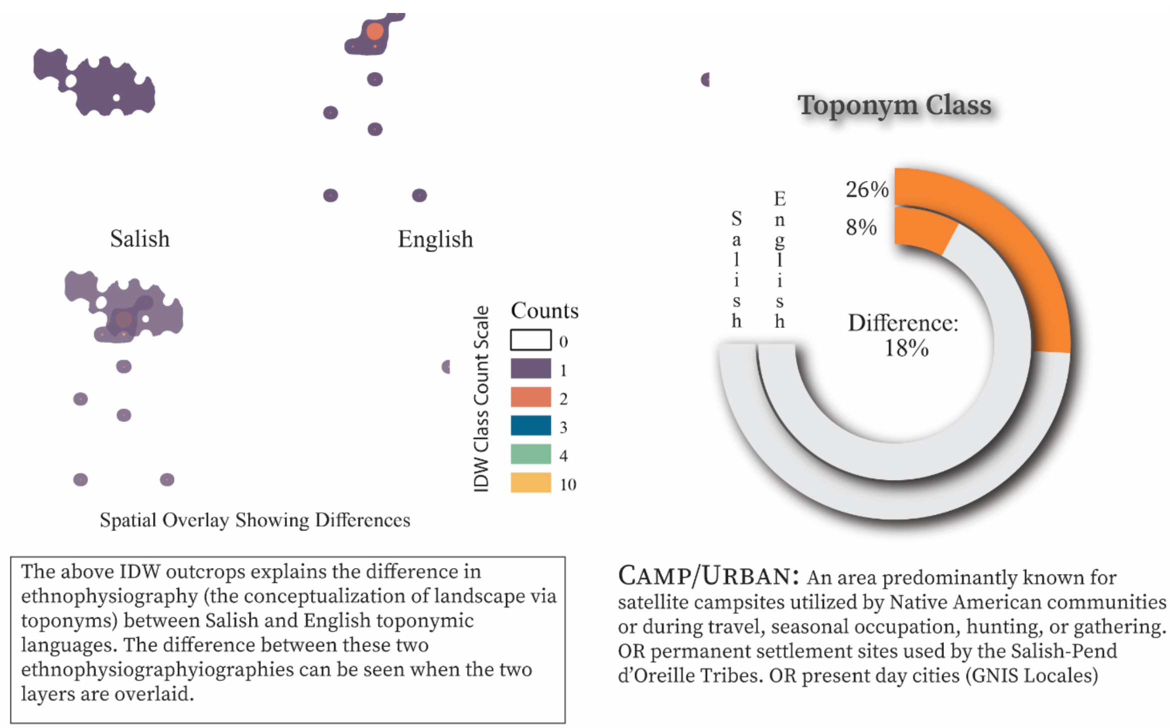

Figure 45: This graphic shows that for the Camp/Urban toponym class, 8% of English points have descriptions that refer to satellite or permanent camping grounds for seasonal use or early settlement sites compared to 26% of Salish points. This shows a difference of 18%.

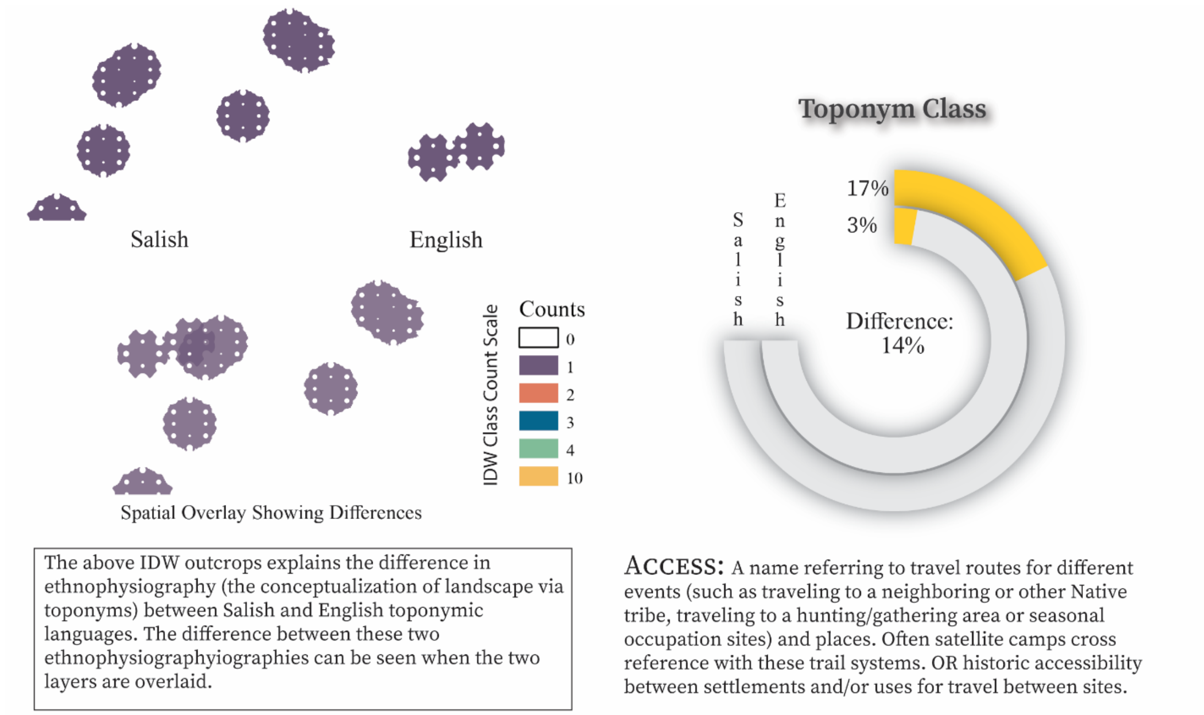

Figure 46: This graphic shows that for the Access toponym class, 3% of English points have descriptions that refer to accessibility to sites or paths used for travel compared to 17% of Salish points. This shows a difference of 14%

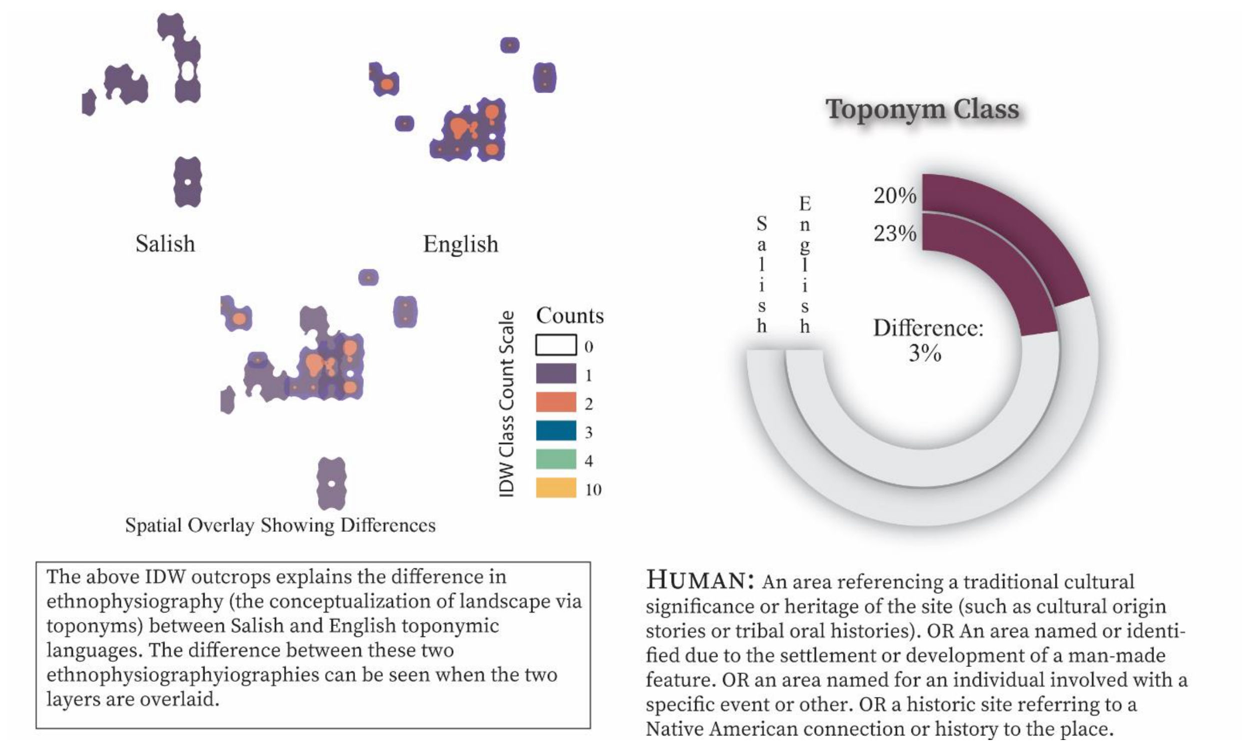

Figure 47: This graphic shows that for the Human toponym class, 28% of English points have descriptions that refer to treaty negotiations, Native American references, or other compared to 3% of Salish points. This shows a difference of 25%

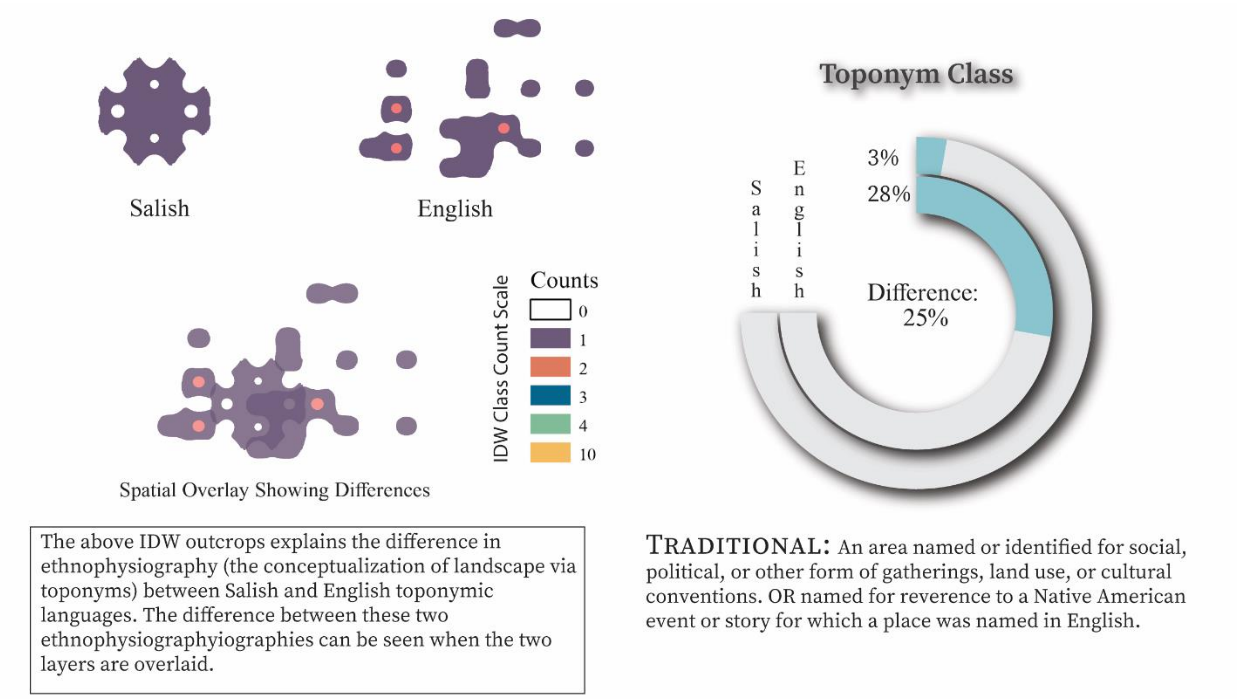

Figure 48: This graphic shows that for the Traditional toponym class, 28% of English points have descriptions that refer to origin stories, ethereal experiences, are eponyms, or other compared to 3% of Salish points. This shows a difference of 25%.

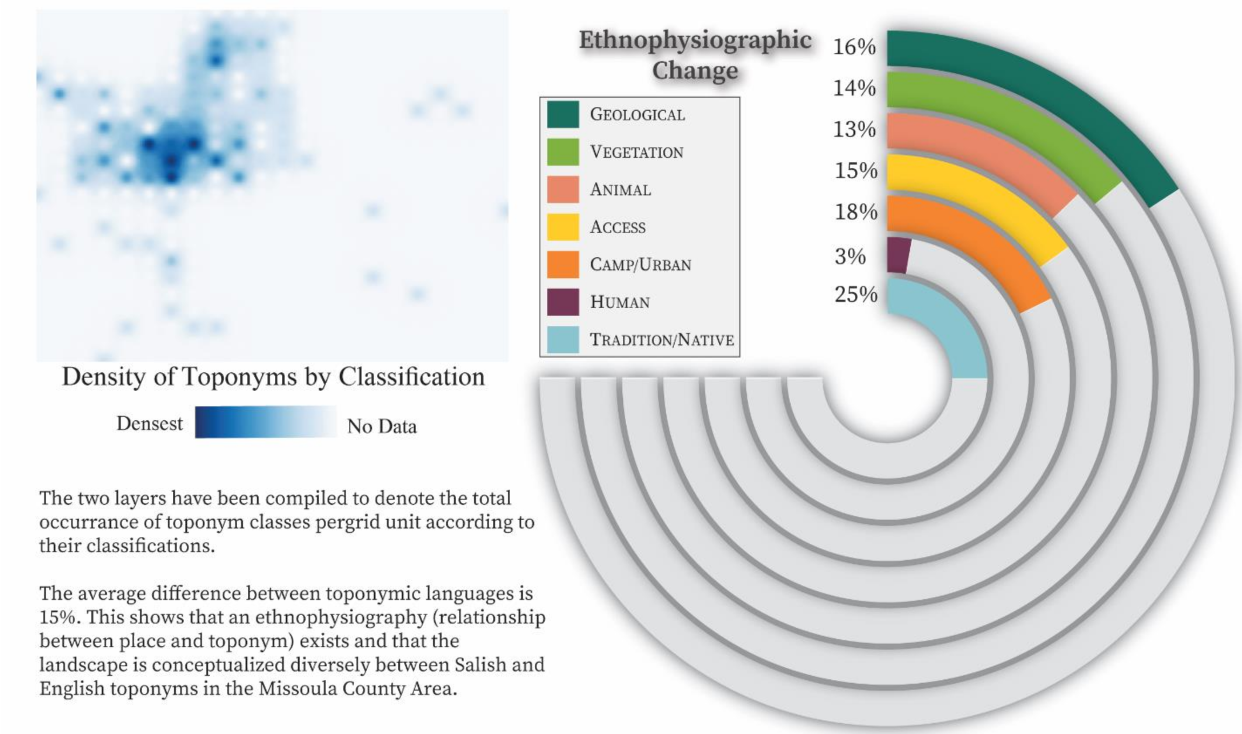

Figure 49: The total Ethnophysiographic difference between linguistic toponyms is approximately 15%. This graphic displays those changes between each classification group.

TOPONYM CLASS	PERCENT OF ETHNOPHYSIOGRAPHIC CHANGE
Geological	31%
Vegetation	15%
Animal	13%
Access	14%
Human	3%
Camp/Urban	18%
Traditional/Native	25%
Unknown	0%

Table 11: Percentage of ethnophysiographic difference between each toponym class.

Ethnophysiography and Land Cover

Landcover information is available for download and open access for a number of research phenomena. The land cover layers used for this study are from 2016, but the 2010 and 2017 land cover layers were closely investigated before making this decision. This is because

2017 is the most recent land cover available but has considerable outlying data from forest fires, which would skew the data, while the land cover from 2010 is the earliest and most complete modern land cover available at a 30-meter resolution. This is significant because the pixel sizes of the land cover convey surface information for a more focused investigation. The 2010 dataset is referenced primarily to understand the average change in land cover between the most recent and earliest modern land cover datasets for reference purposes only. Though the 2017 land cover is the most up to date layer, it has a lot of gaps in the information which can be seen in Figure 50 and 51. Thus the 2016 land cover data set is primarily used to cross-reference the ethnophysiographic measurements and toponymic data collected and analyzed to understand the land cover connection for each toponymic point.

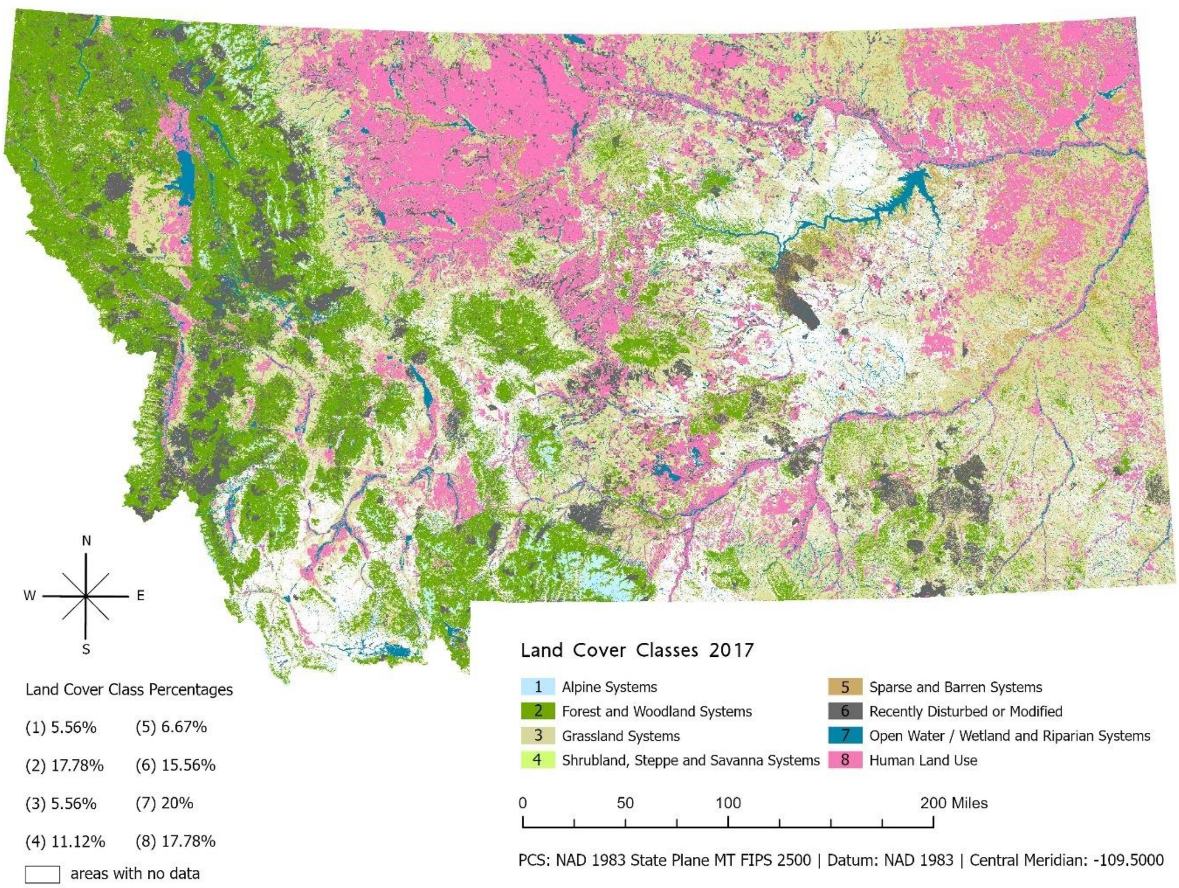

Figure 50: Map of 2017 Land Cover file downloaded from the Montana GIS Clearing House

The following Table 12 represents the ESLF codes that occur in the 2016 land cover of Missoula County and its surrounding areas. These percentages show the spatial occurrence of points to the land cover systems. For example: 2% of the 2016 Land Cover Data falls into ESLF Code 3135 as opposed to Protohistoric that has 3% of data falling into this code.

ESLF CODES	SNAME (SUBSYSTEMS)	ECOLOGICAL SYSTEM	2016	PROHIST
3130	Alpine Ice Field	Alpine	0	0
3135	Alpine Bedrock and Scree	Alpine	2%	3%
5207	Alpine Dwarf-Shrubland	Alpine	0	0
7116	Alpine Fell-Field	Alpine	0	0
7117	Alpine Turf	Alpine	0	0
4104	Aspen Forest and Woodland	Forest and Woodland	0	0

4232	Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	Forest and Woodland	8%	10%
4233	Rocky Mountain Subalpine Woodland and Parkland	Forest and Woodland	1%	0
4234	Rocky Mountain Mesic Montane Mixed Conifer Forest	Forest and Woodland	1%	0
4236	Rocky Mountain Foothill Limber Pine - Juniper Woodland	Forest and Woodland	0	0
4237	Rocky Mountain Lodgepole Pine Forest	Forest and Woodland	3%	0
4240	Rocky Mountain Ponderosa Pine Woodland and Savanna	Forest and Woodland	1%	0
4242	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	Forest and Woodland	2%	0
4243	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Forest and Woodland	1%	3%
4266	Rocky Mountain Montane Douglas-fir Forest and Woodland	Forest and Woodland	0	0
4267	Rocky Mountain Poor Site Lodgepole Pine Forest	Forest and Woodland	0	0
4302	Aspen and Mixed Conifer Forest	Forest and Woodland	0	0
4303	Mountain Mahogany Woodland and Shrubland	Forest and Woodland	0	0
7112	Rocky Mountain Lower Montane, Foothill, and Valley Grassland	Grassland	4%	3%
7113	Rocky Mountain Subalpine-Upper Montane Grassland	Grassland	2%	6%
7118	Rocky Mountain Subalpine-Montane Mesic Meadow	Grassland	0	0
21	Developed, Open Space	Human Land Use	0	0
22	Low Intensity Residential	Human Land Use	1%	0
23	High Intensity Residential	Human Land Use	1%	0
24	Commercial/Industry	Human Land Use	2%	0
25	Railroad	Human Land Use	3%	0
26	Interstate	Human Land Use	0	0
27	Major Roads	Human Land Use	3%	0
28	Other Roads	Human Land Use	8%	0
31	Quarries, Strip Mines and Gravel Pits	Human Land Use	0	0
81	Pasture/Hay	Human Land Use	0	0
82	Cultivated Crops	Human Land Use	2%	0
11	Open Water	Open Water / Wetland and Riparian	30%	0
5000	Geysers and Hot Springs	Open Water / Wetland and Riparian	0	3%
9111	Rocky Mountain Conifer Swamp	Open Water / Wetland and Riparian	0	0
9155	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	Open Water / Wetland and Riparian	12%	6%

9156	Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland	Open Water / Wetland and Riparian	0	10%
9162	Rocky Mountain Wooded Vernal Pool	Open Water / Wetland and Riparian	0	3%
9171	Rocky Mountain Subalpine-Montane Riparian Woodland	Open Water / Wetland and Riparian	0	3%
9187	Rocky Mountain Subalpine-Montane Riparian Shrubland	Open Water / Wetland and Riparian	0	0
9217	Alpine-Montane Wet Meadow	Open Water / Wetland and Riparian	2%	0
9222	Emergent Marsh	Open Water / Wetland and Riparian	0	0
9234	Rocky Mountain Sub-Montane Fen	Open Water / Wetland and Riparian	0	0
9256	Great Plains Saline Depression Wetland	Open Water / Wetland and Riparian	0	0
8403	Introduced Upland Vegetation - Annual and Biennial Forbland	Recently Disturbed or Modified	0	0
8405	Introduced Upland Vegetation - Perennial Grassland and Forbland	Recently Disturbed or Modified	0	0
8501	Recently Burned Forest	Recently Disturbed or Modified	3%	0
8502	Recently Burned Grassland	Recently Disturbed or Modified	0	0
8503	Recently Burned Shrubland	Recently Disturbed or Modified	0	0
8504	Burned Sagebrush	Recently Disturbed or Modified	0	0
8505	Post-Fire Recovery	Recently Disturbed or Modified	0	0
8601	Harvested forest-tree regeneration	Recently Disturbed or Modified	0	0
8602	Harvested forest-shrub regeneration	Recently Disturbed or Modified	2%	0
8603	Harvested forest-grass regeneration	Recently Disturbed or Modified	0	0
8700	Insect-Killed Forest	Recently Disturbed or Modified	1%	0
5209	Low Sagebrush Shrubland	Shrubland, Steppe and Savanna	0	6%
5263	Rocky Mountain Lower Montane-Foothill Shrubland	Shrubland, Steppe and Savanna	0	3%
5312	Rocky Mountain Montane-Foothill Deciduous Shrubland	Shrubland, Steppe and Savanna	0	0
5326	Rocky Mountain Subalpine Deciduous Shrubland	Shrubland, Steppe and Savanna	0	0
5454	Big Sagebrush Steppe	Shrubland, Steppe and Savanna	0	0
5455	Montane Sagebrush steppe	Shrubland, Steppe and Savanna	2%	3%

3129	Rocky Mountain Cliff, Canyon and Massive Bedrock	Sparse and Barren	0	0
0	Background	No Data	0	23%

Table 12: Percentages of land cover where the toponymic points lie according to the ESLF codes of the land cover attribute information from the Montana GNIS Clearinghouse. The land cover values are explained in Table 6 of Chapter Four and the ESLF codes represent the subsystems in Table 11 of this chapter.

Changes occur between the ESLF codes of land cover where the Salish and English toponymic datasets exist. Change between these Ecological Sub-Systems can be spatially viewed in the following maps (Figure 51-57) where the land cover between points is interpolated for visual reference. These outputs were created by using the Natural Neighbor (NN) spatial interpolation tool to (i) simplify the 2016 land cover tied to the toponymic data sets and (ii) to display and calculate the changes on a similar scale as the protohistoric land cover.

Land covers are large raster files that convey surface information on a high pixel resolution. Thus, the 2016 land cover was simplified by extracting ESLF land cover codes of the raster layer where every point (toponym) was located because it allowed the 2016 land cover to be viewed on the same scale as the hand created protohistoric land cover layer rather than viewing 30-meter pixels of land cover where the points resided. This rescaled version of the land cover was completed because an early land cover of the area does not exist at a 30-meter pixel resolution and since that information is often unobtainable, the interpolation GIS tools offer ways in which to view the relationship between points by inferring associated surface information to those areas where no data was present.

Early land covers of the 19th and 20th centuries of five townships in Missoula County have been created using line-based outlines that were classified according to information from historic surveys from GLO by Bobbitt (2015). This method was referenced when creating an early land cover raster from the toponym descriptions, but instead of tracing along the PLSS layer, the interpolative GIS tools were utilized to visually see the connection between points for a easier reference and a consistent comparison. This creation of early land cover and comparison to a 2016 interpolated land cover is important because the change of the Missoula County regional land cover can be observed. Figure 57 illustrates a drastic change in land cover where descriptive landscape information was not directly specified for these areas during the protohistoric era, but are classified as Human Land Use in the 2016 land cover raster, which follow similar spatial patterns.

Figure 51: Alpine Ecological System land cover differences between a hand created land cover during the protohistoric era and 2016 land cover from the Montana GIS Clearinghouse.

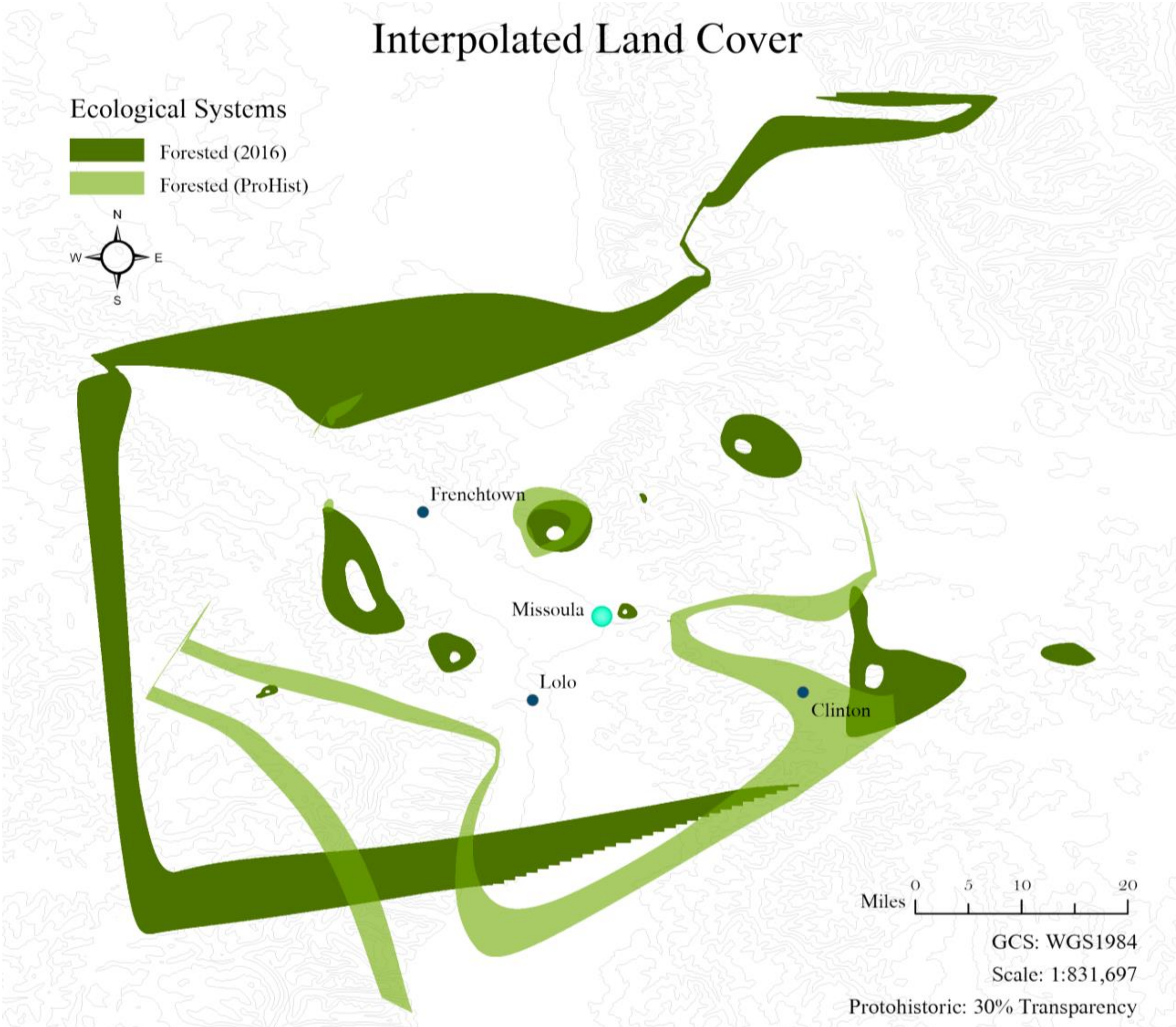

Figure 52: Forest and Woodland Ecological System land cover differences between a hand created land cover during the protohistoric era and 2016 land cover from the Montana GIS Clearinghouse.

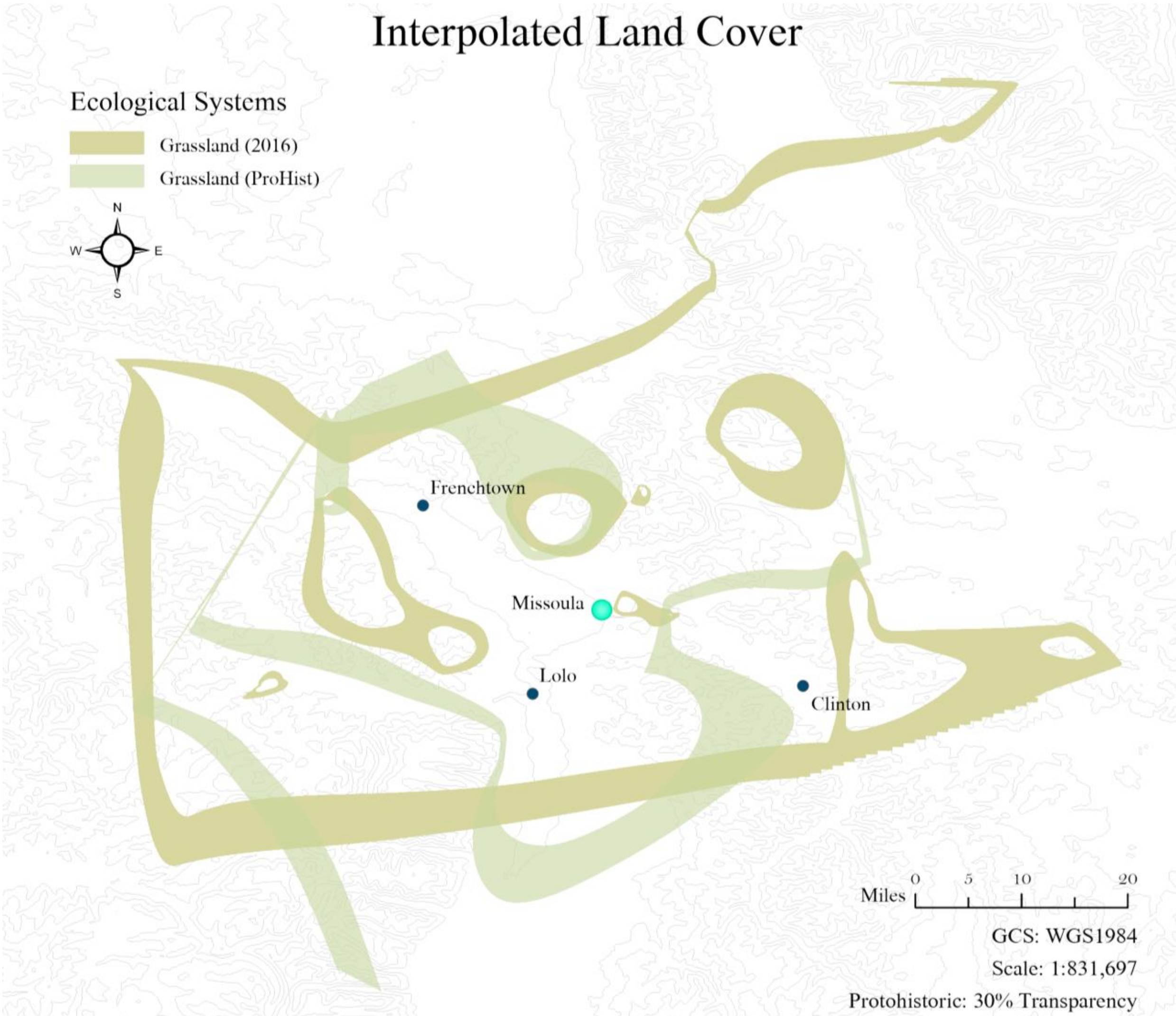

Figure 53: Grassland Ecological System land cover differences between a hand created land cover during the protohistoric era and 2016 land cover from the Montana GIS Clearinghouse.

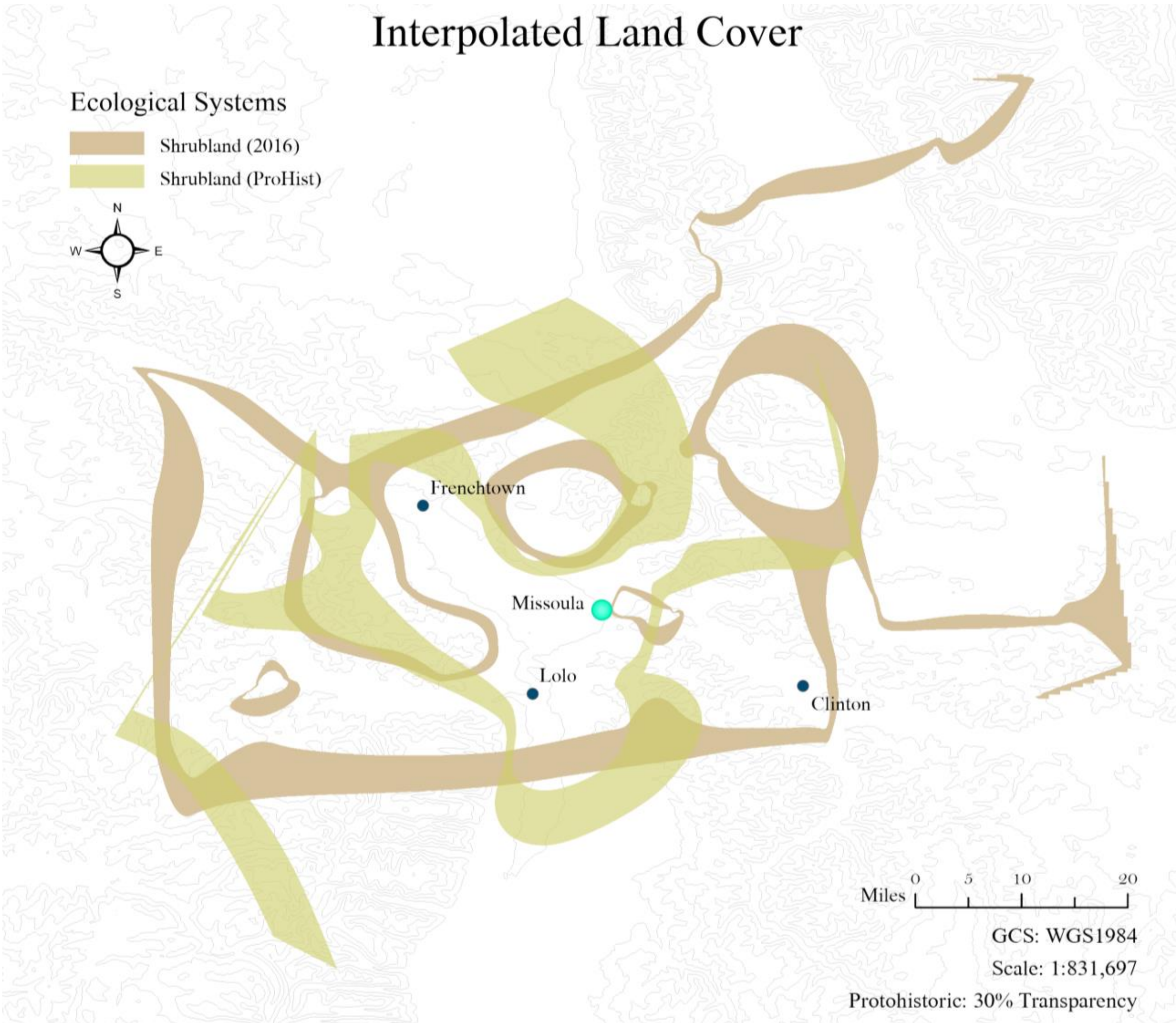

Figure 54: Shrubland, Steppe, and Savanna Ecological System land cover differences between a hand created land cover during the protohistoric era and 2016 land cover from the Montana GIS Clearinghouse.

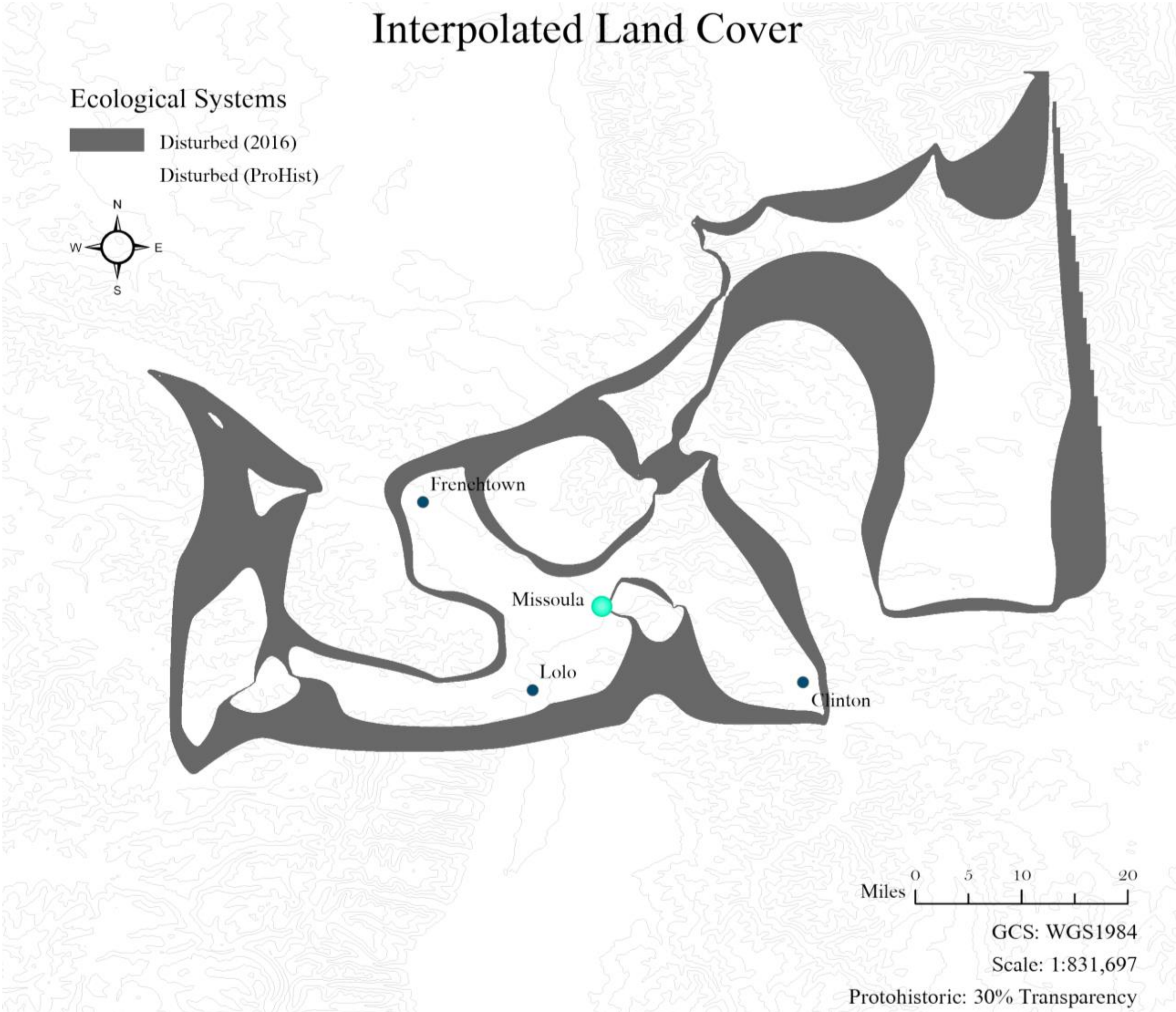

Figure 55: Recently Disturbed or Modified Ecological System land cover differences between a hand created land cover during the protohistoric era and 2016 land cover from the Montana GIS Clearinghouse.

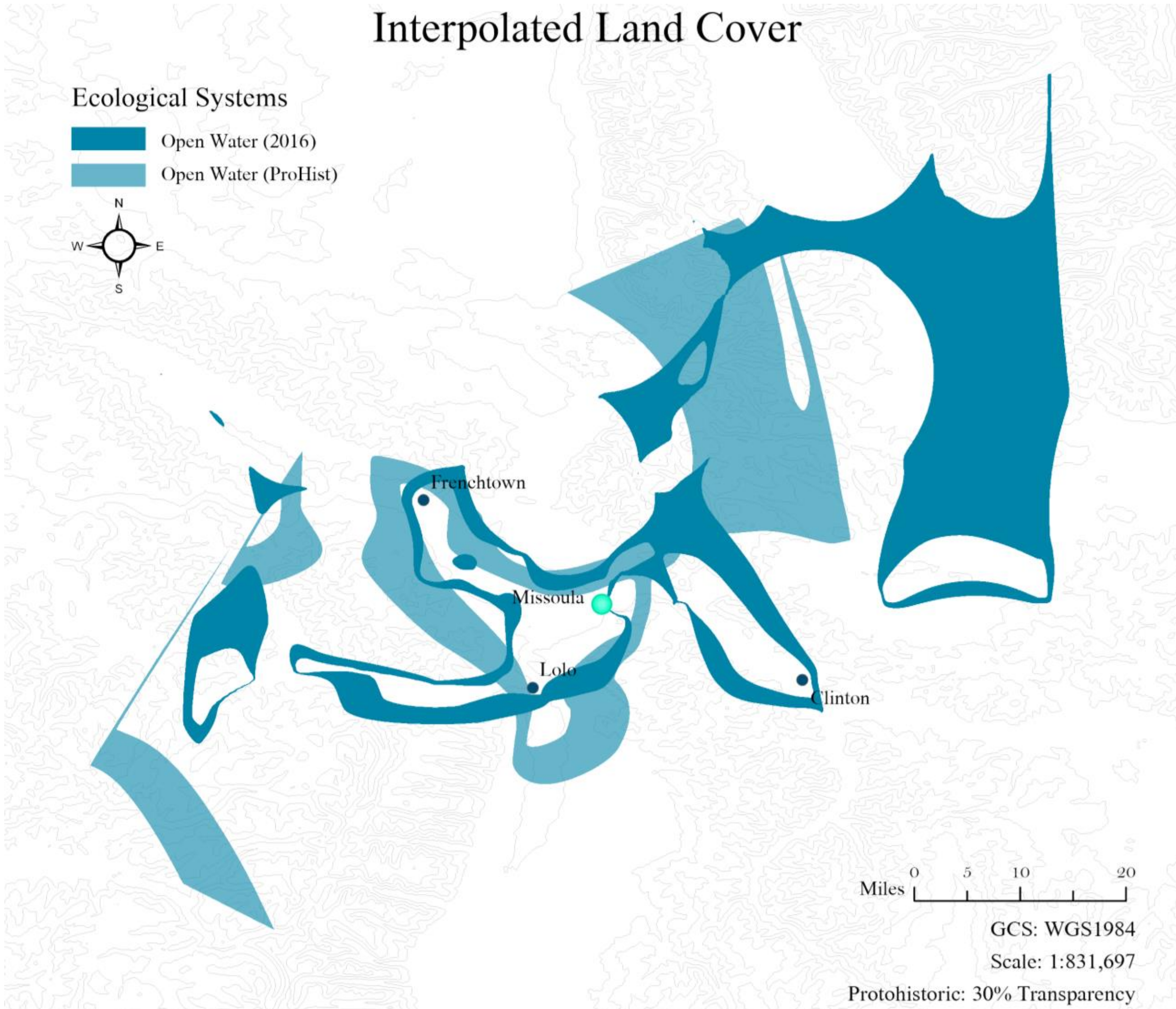

Figure 56: Open Water / Wetland and Riparian Ecological System land cover differences between a hand created land cover during the protohistoric era and 2016 land cover from the Montana GIS Clearinghouse.

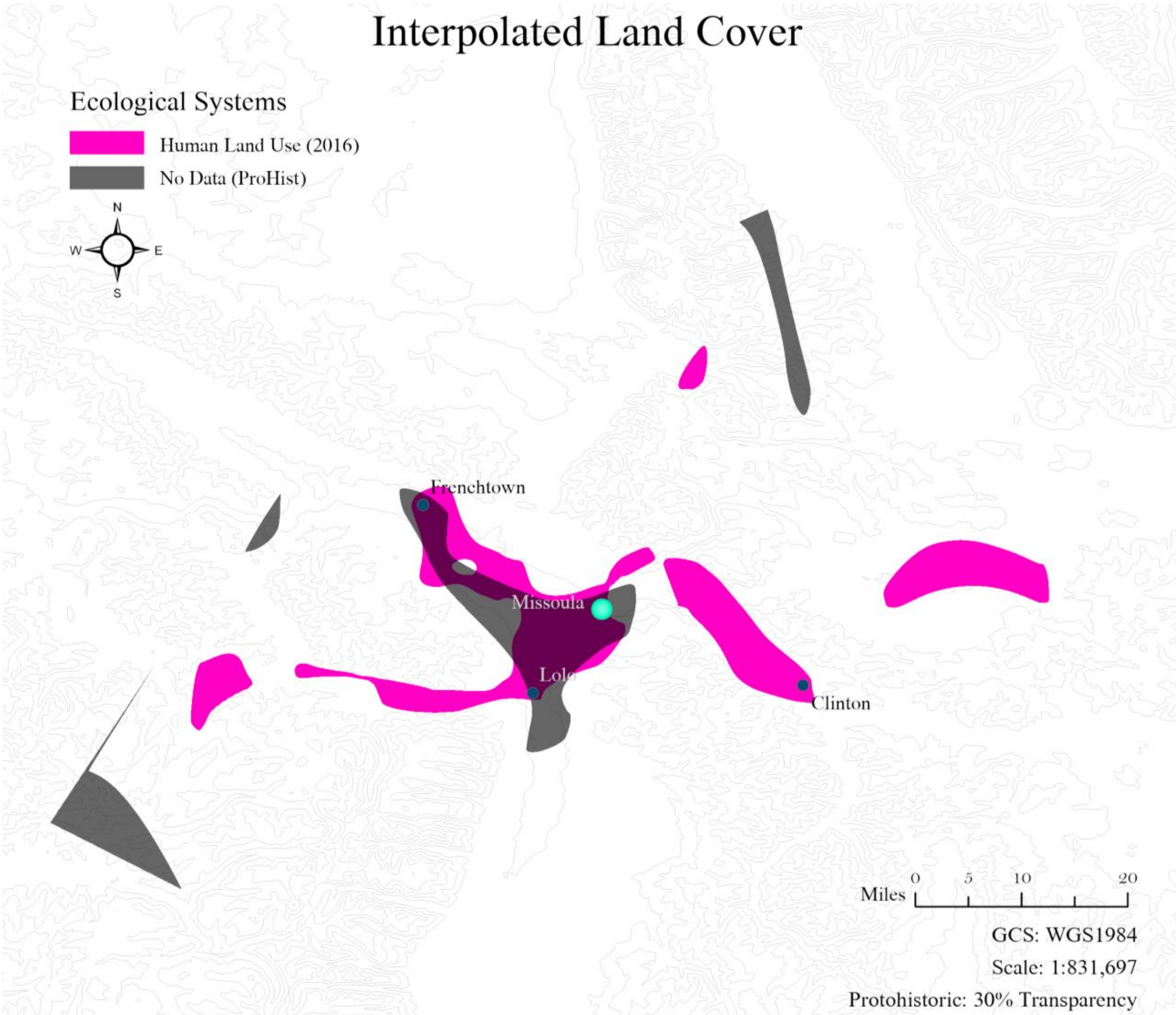

Figure 57: The Human Land Use Ecological System land cover differences between a hand created land cover during the protohistoric era and 2016 land cover from the Montana GIS Clearinghouse. No data that recognizes the 2016 ESLF code/subsystems of land cover observed in the descriptive literature. This map shows an interpolation for where no descriptive landscape information occurred in the literature.

Overall, the changes primarily occurred between the subsystems with ESLF codes of **3135, 4232, 4243, 5455, 7112, 7113,** and **9155**. It is important to also mention that not all of the eight ecological systems are represented on these maps as the body of toponymic points did not occur in areas where these systems exist or describe these systems in the literature. This does not mean that the systems which are not represented do not exist in the study area, but that the body of point data does not intersect these land cover systems. An example of this can be seen in the

Sparse and Barren Systems where no point occurred in this ecological system and no map of this system is listed. The total change in ecological systems from the hand created protohistoric land cover layer to the 2016 land cover layer can be seen in Table 10, where the land cover values are explained in Table 6 of Chapter Four and the ESLF codes represent the subsystems in Table 9 of this chapter.

Land Cover Value	ESLF codes represented in both land covers	Ecological System	% Protohistoric to 2016
1	3135	Alpine Systems	7%
2	4232, 4243	Forest and Woodland Systems	-5%
3	7112,7113	Grassland Systems	10%
4	5455	Shrubland, Steppe and Savanna Systems	15%
5		Sparse and Barren Systems	0%
6		Recently Disturbed or Modified Systems	-6%
7	9155	Open Water / Wetland and Riparian Systems	19%
8		Human Land Use Systems	-20%
9		No Data	23%

Table 13: Consolidated ESLF codes represented in both 2016 and protohistoric land cover data and the percentage of change from protohistoric to 2016 land cover.

Table 10 expresses the percentage where the 2016 land cover is taken from the protohistoric layer. These negative values mean that more points occurred in the 2016 land cover layer for an ecological system than in the protohistoric land cover layer and vice versa. The 2016 land cover information is being taken from the protohistoric layer because it is more recent and denotes a change temporally from the protohistoric era of Missoula County to 2016. The positive values represent a higher quantity of points residing in land covers in the protohistoric layer than the 2016 land cover layer information. An example of this can be seen in the ecological system, Human Land Use. Though the Salish-Pend d'Oreille Tribes did use land/places before Euro-American settlement and residential development, no Human Land Use sub-systems matched any descriptive literature overlapping with ESLF codes and ecological subsystems (i.e. High Intensity Residential (**23**), Railroads (**25**), etc…). This is why Human Land Use Systems shows a -20%. This particular land cover ecological system has changed in residential, agricultural, industrial, or other by 20% since the protohistoric era according to the point datasets. All points from the 2016 land cover investigation reside on areas where data existed. However, not all of the descriptive information provided an insight to protohistoric land cover information for every spatial occurrence of a point. This left holes in the protohistoric land cover data similar to the holes in the 2017 land cover information, which can be seen in Figure 54.

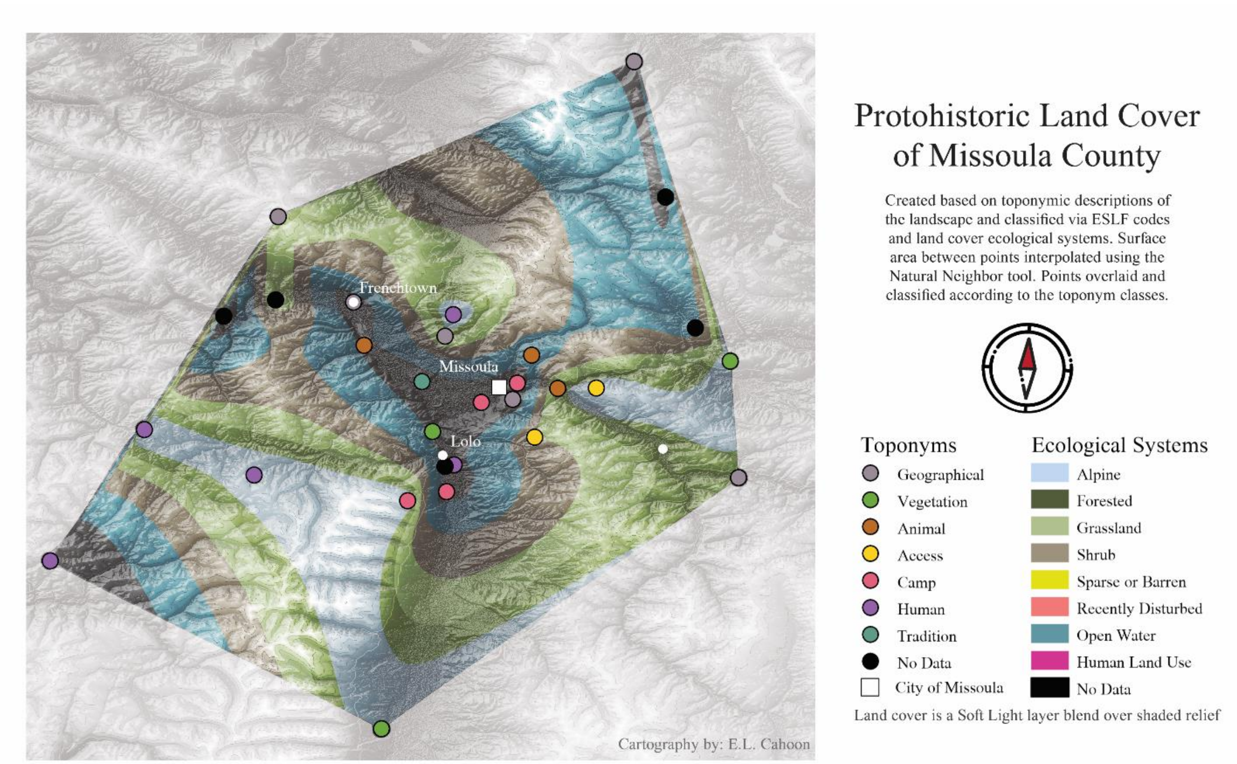

Figure 58: Overview map of toponyms classified to their classes over the protohistoric land cover layer.

To understand the correlation between the toponymic classes and the land cover datasets, the relationship is displayed as percentages in the following table:

Allocation of 2016 Land Cover							
	Toponym Classes						
Ecological Systems	Geographical	Vegetation	Animal	Access	Camp/Urban	Human	Traditional
Alpine	3%						
Forest	3%	4%	4%	1%	1%	3%	2%
Grassland	4%		2%			1%	6%
Shrub		1%	1%	1%			
Barren							
Disturbed	2%	1%	2%	1%		1%	
Open Water	18%	6%	6%	1%		2%	
Human Land Use	5%				6%	3%	4%

Table 14: Percentages showing the ecological systems in which the toponyms reside according to the 2016 Land Cover dataset.

By adding the percentages of 2016 Land Cover Data Allocations, we can prove an ethnophysiography of Missoula County. Table 11 shows that 95% of the toponyms that were studied will fit into Toponym Classes and Ecological Systems, which conclusively shows the relationship between language and landscape via place names and land cover.

For a closer investigation of this relationship, the four sites in Figure 55 are inspected.

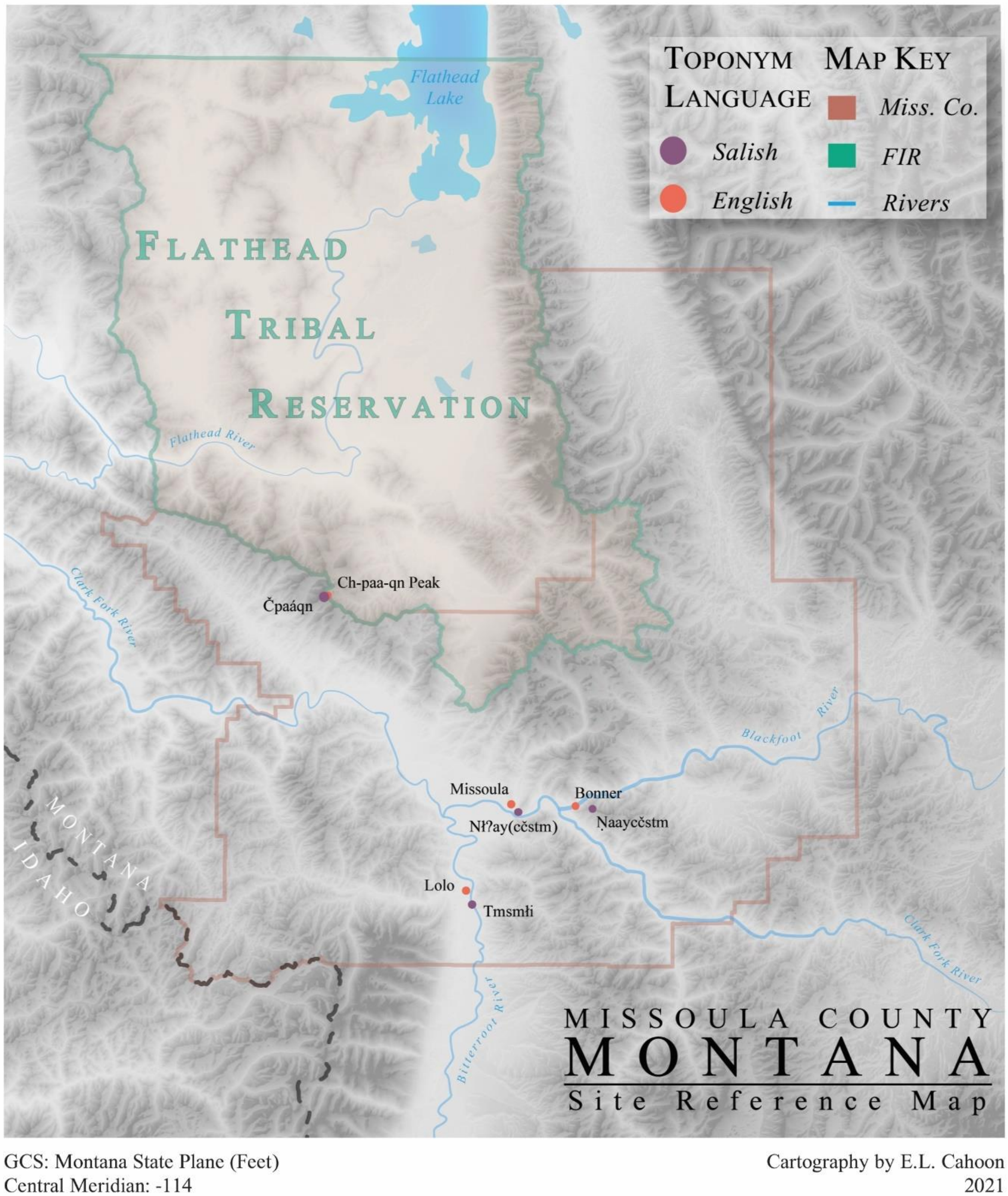

Figure 59: Reference map of four sites from each toponym dataset where points lie spatially proximate.

Summary of Ethnophysiography and Land Cover Analysis

The previous section tested for **H2-** *The relationship of toponyms and landscape is diversely conceptualized between place names of different languages*- by (i) building toponymic and land cover datasets to understand the relationship between landscape and place names and (ii) implementing a surface and comparative analysis in GIS. From this toponymic and spatial investigation, we have learned that

1. Toponyms emit an ethnophysiography of Missoula County through their descriptions.
2. This ethnophysiography does differ diversely between the Salish and English toponymic datasets.
3. A significant percentage of land cover has changed since the protohistoric era reflecting a similar trend in place name descriptions.

Hypothesis Confirmation and Rejection

Based on these results, this thesis confirms **Hypothesis 1**: *The relationship expressed between toponyms of diverse languages and landscape should not statistically produce a Zipfian Distribution because places are named intentionally* and **Hypothesis 2**: *The relationship of toponyms and landscape is diversely conceptualized between place names of different languages.* This thesis rejects both null hypotheses.

H1 The relationship expressed between toponyms of diverse languages and landscape should not statistically produce a Zipfian Distribution because places are named intentionally.	**Accepted**
H2 The relationship of toponyms and landscape is diversely conceptualized between place names of different languages.	**Accepted**

NH1 The relationship expressed by the toponyms of diverse languages, should statistically produce a Zipfian Distribution because places are named randomly.	**Rejected**
NH2 The ethnophysiography of Missoula County is not conceptualized diversely between the different toponym languages.	**Rejected**

Table 15: Hypotheses rejection and confirmation

Chapter Six: Discussion

"Someday soon map collectors will discover cartographic insults."

-Monmonier (2015:1)

Discussion

What does this investigation of Missoula County ethnophysiography tell us about landscape and toponyms from diverse languages? The most salient outcome from this research is that non-urbanized toponyms do assume a conceptualization of place through intentional naming practices via land cover comparisons in GIS. Likewise, place conceptualization according to toponym descriptions do denote a difference between place names of different languages. Thus, the focus of this thesis aimed to understand the ethnophysiography of Missoula County and its surrounding areas through the relationship of toponyms and landscape. This relationship is embodied with the culture, terrestrial knowledge, and cognitive experiences of generations who have occupied these landscapes since the last draining of Glacial Lake Missoula.

The logical processes of this thesis began with the hypotheses: *The relationship expressed between toponyms of diverse languages and landscape should not statistically produce a Zipfian Distribution because places are named intentionally* and *the relationship of toponyms and landscape is diversely conceptualized between place names of different languages.* These hypotheses were tested by investigating toponymic descriptions of Missoula County by creating geodatasets of Salish and English toponyms for spatial and statistical analysis and processed using interpolative surface tools in ArcGIS Map and ArcGIS Pro. Framing this research with a phenomenological underpinning led this research to studying qualitative datasets to be investigated empirically without the loss of cultural integrity in the toponymic attributes.

Issues in the Research

After conducting this research, it is clear that this examination should have been organized and analyzed in phases. What this means is that since the toponymic descriptive data is so extensive and involves, at times, multiple perceptions according to land use of why a place was named, these classification methods should be employed regarding multiple levels of naming on a scale of importance, quantitative, or temporal utilization. To explain this claim, an example from a lake in Northern Missoula County will be used. If Lick Lake is named because of the number of animals that come to lick/drink from its waters, then it is evident that this toponym should be classified according to the animals that primarily use it. However, under closer investigation, the reason for the animal's attraction to drink from this particular body of water is due to the natural saline deposits which make the taste of the waters more appealing to the wildlife. This also suggests that this name belongs to the *geographical* classification category. It is in this situation that, for this study, Lick Lake was classified under *animal*, as to follow a sequential order of events where the name specifically reflects the tongues of the animals or other licking the water and is not named for the natural saline waters which is the cause of the licking. One suggested method to address this issue is to invest in this research to further investigate all possible classes of a place name and create multiple geodatabases for each classification. This will narrow subjective information.

Other issues in the research are shown through historic and Indigenous maps used to georeferenced sites in ArcMap. Upon investigation, some sites labeled on maps do not always match the suggested area of a place, or do not strictly follow geographical descriptions of the place. This could be for various reasons. As stated earlier in this thesis, boundaries for places are not always known or drawn for protective or sacred reasonings. However, the general areas can be assumed for referencing and spatial orientation purposes. This could also offer an insight as to why many Indigenous maps reference the toponym and not a direct point compared to modern atlases which feature points for populated places or locals. These issues in the data collection process can be addressed through a collaborative effort in future research or by adding an ethnographic component to investigate these sites more closely on an interpersonal level.

Measuring ethnophysiography in Missoula County using GIS also has its own set of issues, which is why so many steps had to be taken to make sure the measurements were accurately producing qualitative data in a way that did not disturb the ordinal information behind the data. Likewsie, when using the Natural Neighbor tool to create a protohistoric land cover layer and rescale the 2016 land cover layer, some errors do exist. Since the spatial area of the Missoula County region is large and the sample size of data points is small, some areas illustrated in the land cover comparison maps do not always constitute an exact land cover. An example of this can be seen in Figure 60, which displays where points occur that fall under the Alpine Ecological System but span across lower elevation areas to show this connection between the points that do have an Alpine land cover.

Figure 60: Issues in using interpolative tools to simplify and reference land cover between points.

To remedy this error, an ethnographic investigation of toponyms can be applied to build a larger geodatabase of points. The more points available for analysis, the more accurate the interpolated surface between those points will be.

Furthermore, GIS has many functions and serves a plethora of disciplines to analyze data. The methodological possibilities extend greatly for conducting an ethnophysiographic investigation of a particular spatial region. The methodologies used for this thesis were modeled after archaeological distribution techniques, land cover investigations, and ArcGIS geoprocessing tool familiarity. Combining these practices offers a method to extend and/or study ethnophysiography for future research.

Future Research

Since this research highlights cross-disciplinary practice, future research can be investigated in a number of fields. However, for the purpose of this thesis, four directions will be discussed here (i) archaeologically, (ii) cartographically, (iii) cognitively, and (iv) statistically.

While the archaeological record was referenced in understanding land use for sites in the toponymic datasets and geography was employed to spatially determine and measure ethnophysiography, more centered concentrations can be applied from this thesis. Future archaeological investigations can be applied to confirm or deny land use to toponyms through material culture. While this material culture was referenced for some sites, a deeper examination through lithics and other artifact bodies can be analyzed against place name descriptions. Since there are several archaeological fields employed in the county, temporal eras can expressively be studied. This means that material culture can be used to support or agree with the layers of toponymic descriptions from Indigenous, historic, or other archaeological subfields. One such research endeavor concentrating on archaeologies of the 19^{th} and 20^{th} centuries can be seen in Bobbitt (2015).

Currently, the US Board on Geographic Names is developing a descriptive explanation section for toponymic definitions on the GNIS database which records place name origins and other significant information. While this project is on a nationwide scale, smaller projects invest in this style of preservation and embodied toponymic culture across multiple communities. Indigenously, the Plateau People's Web Portal has published maps which recognize places with toponyms labeled in the traditional Salish language. This promotes heritage and preservation of landscape and culture and motivates efforts in cartographic decolonization and recognition. Furthermore, place based historic information from community involvement and local archival records has come together to produce an interactive online platform of Missoula County digital heritage through the Map Missoula Project. With regards to future contributions from this research, a conception of place can be mapped and cartographically denote the significance of ethnophysiographic relationships of place in the Missoula County region. Similar cartographic influences regarding ethnophysiographic mapping styles include Hawaiian storied maps seen in Louise (2011) and embodied significance of landscape in Oaxaca, Mexico by O'Connor and Kroefges (2007).

A growing popularity of cognitive language and linguistic studies has emerged in the last few decades. An improvement of technology from medical and geographical disciplines has propelled cognitive research in the social scientific fields and motivated an integration between it and the physical sciences. This thesis can be seen as a spatial investigation of ethnophysiography through toponyms of Missoula County and be further investigated through the use of cognitive virtual realities for a number of reasons. Firstly, ethnophysiography investigates and suggests a mental perception of landscape via language. While this can be investigated and confirmed based on land use and land cover as demonstrated in this thesis, cognitive research by use of virtual reality and EEGs can contribute to confirming experiences of place through tangible means. Examples of similar research can be seen in archaeological disciplines for site reconstruction and investigation in digital heritage fields and mental cognition of past experiences. Research investigating these examples include a reconstruction of the Çatalhöyük site in Turkey by Dennis (2018), and evolutionary cognitive archaeology of Paleolithic artifacts investigated by Garofoli (2017). Likewise, as neurophenomenology investigates experiences on a neurobiological level, this thesis can be further investigated to understand the experience of place through the use of cognitive technologies like EEG. Examples of research which examine environmental cognition include physical monitoring of landscape perceptions by Hedblom et al. (2019), naturalistic environments by Tromp et al. (2017), and physical and mental well-being by Bailey et al. (2018).

Statistically, this thesis fitted the data to a power law to further understand what the relationship between frequency and rank could tell me about Missoula County toponyms. Compared to the microtopnymic investigation by Villette and Purves (2018), this thesis data expressed lower R^2 values, which means that my data is not power law distributed. However, as demonstrated by the constant dataset used in my statistical analysis, the data might be Zipfian distributed with a larger corpus of data to analyze. Moving forward, this thesis could be expanded upon by building the corpus of toponyms of Missoula County and fitted to a power law using technologies directly suited for analyzing a Zipf's Law over Excel, which could result in more precise expressions of the data.

Research Importance and Decolonizing Cartography

Heritage is an essential feature to modern society in that it embraces the past, motivates equality, and promotes positive efforts in the future. Understanding the conceptualizations humans have with the landscape exhibits importance for wildlife habitats and human land use, climate change, urban planning and development, and general health and human well-being initiatives. This thesis offers a small contribution to the body of ethnophysiographic research and promotes the recognition of place as it is experienced through place names and landscapes. Today, a trend of reclaiming toponyms has spread through Missoula and its valleys. While locals may still know of this peak as Squaw Peak, the traditional Salish name has been restored to it- *Čpaáqn* (Personal Communication 2021). Its anglicized rendition, Ch-paa-qn, is the official name seen on the GNIS database and the recreational and cultural interest road signs. Likewise, with the Higgins Street bridge construction, a commemorative renaming is being suggested in recognition of a Salish individual. This eponym refers to an act of leadership while crossing the Clark Fork River during the time of forced removal from the Bitterroot Valley (CSKT 2021). Likewise, in early 2021, collaborative efforts between Missoula County commissioners and CSKT are looking to reclaim the Salish name of the present-day Mullen area off of I-90, which recognizes the Indigenous cultural significance of the site (Miller 2021).

Moreover, efforts similar to this transition in cartographic identification and motivate the use of geographic tools like GIS to decolonize the practice where traditional Western culture emphasizes the importance of officiality. Cartography is a tool that can be used to address this stigma of place and place names and to debunk the idea that since there are federally recognized databases of toponyms, that previous toponyms (in any language) are no longer recognized or used in society. Additionally, these toponymic reclamations warrant a use of these geographic technologies to create cultural representational maps by members of said culture (Leonard 2021). The efforts toward these cartographic practices also address issues of pejorated language which was chosen to represent specific landscapes. As Monmonier (2015) states, cartographic insult exists and, in most cases, is not resolved until a change is made.

Conclusion

This thesis was able to accurately show that ethnophysiography can be investigated via Missoula County toponymy, it differs between toponym languages, and does not express a Zipfian distribution, which means that names are bestowed to landscapes intentionally. While this research began as an investigation to understand toponymic change over time from the protohistoric era to today, it has transitioned into an intimate look at the relationship place names and their places have and how those relationships differ between toponyms of different languages and the embedded information they carry. As a discipline, ethnophysiogrpahy provided a framework for which to conduct this research and phenomenology presented a way in which to organize and collect the data used for this research. While the focus shifted from distinct investigations of these linguistic and environmental facets across time, cartographic significance presented the idea that while temporal hierarchies are important, heritage of the landscape and its toponyms suggest a more concise ideal of the meaning behind the name. Thus, by changing the concentration of this project from across time, to across language, the data and the results emphasize a relationship between names and places that is still recognized today among the languages presented in this thesis.

Bibliography

Aarstad, Rich, Ellie Arguimbau, Ellen Baumler, Charlene Porsild, and Brian Shovers

2009 *Montana Place Names from Alzada to Zortman: A Montana Historical Society Guide.* Montana Historical Society Press, Helena.

Abadi, Mark

2018 "27 Fascinating Maps that Show How Americans Speak English Differently Across the US". Insider. https://www.businessinsider.com/american-english-dialects-maps-2018-1

Abdikhalikovna, Khayitova Feruza

1996 Principles of Toponyms (Place Names) Classifications. *International Journal of Multicultural and Multireligious Understanding* 7(2020): 73-79.

Aleto, Cliff

2001 Land, Science, and Indigenous Science: Tales from a Modern Treaty Negotiation Process. In, *Science and Native American Communities* pp.155-163. University of Nebraska Press, Lincoln.

Alt, David

2001 *Glacial Lake Missoula and its Humongous Floods.* Montana Press Publishing Company, Missoula.

Alt, David and Donald W. Hyndman

1986 *Roadside Geology of Montana*, Montana Press Publishing Company, Missoula.

Altaweel, Mark

2021 How Maps Affect Perception. GIS Lounge, Maps and Cartography. https://www.gislounge.com/how-maps-affect-perception/

2017 GIS and Virtual Reality. GIS Lounge, GIS Industry. https://www.gislounge.com/gis-virtual-reality/

Anschuetz, Kurt F., Richard H. Wilshusen and Cherie L. Scheick

2001 An Archaeology of Landscapes: Perspectives and Directions. *Journal of Archaeological Research* 9(2):157-211.

Bailey, Andrew W. and Hyoung-Kil Kang

2017 Cognitive and Physiological Impacts of Adventure Activities: Beyond Self Report Data. Research Gate.

Bailey, Andrew W., Garrett Allen, Josh Herndon, and Christian Demastus

2018 Cognitive Benefits of Walking in Natural versus Built Environments. *World Leisure Journal*, UTC Brain Wave Project.

Barrett, John C. and Illhong Ko

2009 A Phenomenology of Landscape. *Journal of Social Archaeology* 9(3):275-294(1469-6053).

Basso, Keith H.

1996 *Wisdom Sits in Places: Landscape and Language Among the Western Apache.* University of New Mexico Press, Albuquerque.

Bear Don't Walk, Mitchell Rose
2019 Recovering our Roots: The Importance of Salish Ethnobotanical Knowledge and Traditional Food Systems to Community Wellbeing on the Flathead Indian Reservation in Montana. Master's thesis, Department of Environmental Studies, University of Montana. https://scholarworks.umt.edu/etd/11494

Bobbitt, Mary
2015 The Historical and Cultural Landscape of the Missoula Valley During the 19th and 20th Centuries. Master's thesis, Department of Anthropology, University of Montana. https://scholarworks.umt.edu/etd/4541.

Borden, Charles E.
1979 Peopling and Early Cultures of the Pacific Northwest. *Science* 203(4384) 963-971. American Association of the Advancement of Science.

Brabyn, Lars
2009 Classifying Landscape Character, *Landscape Research* 34(3):299-321.

Brown, Penelope
2008 Up, Down, and Across the Land: Landscape Terms, Place Names, and Spatial Language in Tzeltal. *Language Sciences* 30:151-181.

Brück, Joanna
2005 Experiencing the Past? The Development of a Phenomenological Archaeology in British Prehistory. *Archaeological Dialogues,* Cambridge University Press.

Buckley, Jay H.
2006[1998] Lewis and Clark Expedition. *United States History*, Britannica. https://www.britannica.com/event/Lewis-and-Clark-Expedition

Burenhult, Niclas and Stephen C. Levinson
2008 "Language and Landscape: a Cross-Linguistic Perspective". Elsevier. doi:10.1016/j.langsci.2006.12.028.

Bancroft, Hubert H.
1890 *History of Washington, Idaho, and Montana 1845-1889*. The History Company, San Francisco Vol. XXXI.

Cablitz, Gabriele H.
2008 When "what" is "where": A Linguistic Analysis of Landscape Terms, Place Names and Body Part Terms in Marquesan (Oceanic, French Polynesia), Language Sciences. 30 200-226. Elsevier.

Calvo-Iglesias, María Silvia, Ramón Alverto Díaz-Varela, Gonzalo Méndez-Martínez and Urban Fra-Paleo
2012 Using Place Names for Mapping the Distribution of Vanishing Historical Landscape Features: The Agras Field System in Northwest Spain. *Landscape Research* 37(4) 501-517.

Catlin, George
1903 Letter-No. 48. In *North American Indians*, Edinburgh 2:123-130.

Chloupek, Brett R.
2018 A GIS Approach to Cultural and Historical Toponymic Research in Nebraska. *Journal of Cultural Geography* 35(1):23-43.

Clarke, Michael
2010 *The Concise Oxford Dictionary of Art Terms* 2nd ed, Oxford University Press.

Cogos, Sarah, Marie Roue and Samuel Roturier
2017 Sami Place Names and Maps: Transmitting Knowledge of a Cultural Landscape in Contemporary Contexts. Arctice, Antarctic, and Alpine Research 49(1):43-51.

Confederated Salish and Kootenai Tribes (CSKT) of the Flathead Reservation
2021 Honoring the Past to Ensure the Future. https://csktribes.org/index.php/history-and-culture

Crampton, Jeremy W.
2002 Thinking Philosophically in Cartography: Toward a Critical Politics of Mapping. *Cartographic Perspectives* 41, winter.

Csordas, Thomas J.
1990 Embodiment as a Paradigm for Anthropology. *Ethos* 18(1):5-47.
2015 Toward a Cultural Phenomenology of Body-World Relations. *Phenomenology in Anthropology: A Sense of Perspective*, Indiana University Press, Bloomington. Edited by Kalpana Ram and Christopoher Houston 2:50-67.

Darvill, Timothy
2009 *The Concise Oxford Dictionary of Archaeology* 2nd ed, Oxford University Press.

Data USA
2019 USA Data: Missoula County. Deloitte. https://datausa.io

Daurio, Corrie Maya
2009 Exploring Perspectives on Landscape and Language among Kaike Speakers in Dolpa, Nepal. Master's thesis, Department of Geography, University of Montana, Missoula.

Davis, Carl M.
2019 *Six Hundred Generations: An Archaeological History of Montana*. Riverbend Publishing, Helena.

Dennis, Meghan
2018 Recent Emotive Fieldwork at the site of Çatalhöyük in Turkey. EMOTIVE: Storytelling for Cultural Heritage. University of York, York. https://emotiveproject.eu/index.php/2018/11/23/recent-emotive-fieldwork/

Desjarlais, Robert and C. Jason Throop

2011 Phenomenological Approaches in Anthropology. *Annual Review of Anthropology* 40(1):87-102.

Dixon, Kelly
2014 Historical Archaeologies of the American West. *Journal of Archaeological Research,* 22(3):177-228.

Division of Indian Education and Montana Office of Public Instruction
2009 *Montana Indians: Their History and Location*. A+ Indian Education.

Dunn, Christine E.
2007 Participatory GIS- a People's GIS. *Human Geography* 31:616, Sage Publications.

Eberhard, David M., Gary F. Simons, and Charles D. Fenning
2021 Ethnologue: Languages of the World, Dallas. Ed. 24. http://www.ethnologue.com.

Everett-Heath, John
2020 *Concise Oxford Dictionary of World Place Names* 6th ed. Oxford University Press.

Fagúndez, Jaime and Jesús Izco
2016 Diversity Patterns of Plant Place Names Reveal Connections with Environmental and Social Factors. *Applied Geography,* Elsevier.

Falk, John H. and John D. Balling
2010 Evolutionary Influence on Human Landscape Preference. *Environment and Behavior* 42:479.

Feltes, Heloísa Pedroso de Moraes
2010 Embodiment in Cognitive Linguistic: From Experientalsm to Computational Neuroscience. *DELTA: Documentação de Estudos em Lingüística Teórica e Aplicada.* 26:503-533.

Fisher, Foster B., J. Chris Winne, Michele M. Thornton, Troy P. Tady, Zhenkui Ma, Melissa M. Hart, Roland L. Redmond
1998 *Montana Land Cover Atlas.* The Montana Gap Analysis Project. Wildlife Spatial Analysis Lab, Missoula.

Friedland, Maria
2009 Phenomenology and Anthropology: The Question of Man. *Rivista di Storia della Filosofia* 64(3):547-548. FrancoAngeli srl.

Fuchs, Stephan
2015 Toponymic GIS- Role and Potential of Place Names in the Context of Geographic Information Systems and GIS. *KN- Journal of Cartogarphy and Geographic Information* 65(6):330-337.

Gallagher, Shaun
2012 *Phenomenology*. Palgrave Macmillan, New York.

Gallagher, Shaun and Daniel Schmicking
2011 *Handbook of Phenomenology and Cognitive Science.* Springer, New York.

Garofoli, Duilio
2017 RECkoning with Representational Apriorism in Evolutionary Cognitive Archaeology. *Phenomenology and Cognitive Sciences* 17(5):973-995.
2019 Embodied Cognition and the Archaeology of Mind: A Radical Reassessment. In *Handbook of Evolutionary Research in Archaeology*, edited by Anna Marie Prentiss. Springer.

Glenn, Stephanie
2016 Power Law and Power Law Distribution, Statistics Know How To. https://www.statisticshowto.com/power-law/

Gillings, Mark
2012 Landscape Phenomenology, GIS and the Role of Affordance. *Journal of Archaeological Method and Theory* 19:01-611.

Gordon, Jeffrey J.
2013[1984] Onondaga Iroquois Place-Names: An Approach to Historical and Contemporary Indian Landscape Perception. *Names: A journal of Onomastics* 32(3):218-233.

Goudie, Andrew
2000[1981] *The Human Impact: On the Natural Environment. The MIT Press*, Cambridge 5.

Habeck, James R.
1967 *The Vegetation of Northwestern Montana.* University of Montana, Missoula.

Hărmănescu, Mihaela and Andreea Popa
2013 A New Landscape Perspective- Human Exercises through Time in Environmental Perception. *Social and Behavioral Sciences* 92:385-389.

Hart, Jeff
1976 *Montana Native Plants and Early Peoples*. Montana Historical Society Press, Helena.

Hedblom, M., H. Hedenås, M. Blicharska, S. Adler, I. Knez, G. Mikusiński, J. Svensson, S. Sandström, P. Sandström, and D.A. Wardle
2019 Landscape Perception: Linking Physical Monitoring data to perceived landscape properties. *Landscape Research,*

Heidegger, Martin
1971 [1959] *On the Way to Language*. Harper Collins Press, San Francisco.
1962 *Being and Time*. Harper and Row Publishers Incorporated, New York.

Henshaw, Anne
2006 Pausing along the Journey: Learning Landscapes, Environmental Change, and Toponymy Amongst the Sikusilarmiut. *Arctic Anthropology* 43(1):52-66.

Higuchi, Tadahiko
1988 *Visual and Spatial Structures of Landscape*. MIT Press, Cambridge.

Hirsch, Eric and Michael O' Hanlon

1995 *The Anthropology of Landscape: Perspectives on Place and Space.* Clarendon Press, Oxford.

Kuhn, Werner
2002a Geospatial Semantics: Why, of What, and How? *Journal on Data Semantics III* 1-24. Lecture Notes in Computer Science, vol 3534. Springer, Berlin, Heidelberg. https://doi.org/10.1007/11496168_1.

Kuhn, Werner
2002b Modeling the Semantics of Geographic Categories through Conceptual Integration. In *Lecture Notes in Computer Science (including subseries Lecute Notes in Artificial Intelligence and Lecture Notes in Bioinformatics),* 2478 pp. 108-118. Springer, Verlag.

Kurtz, Wendy
2013 Wendy Perla Kertz, Research. http://www.wendyperlakurtz.com/

Lackoff, George and Mark Johnson
1999 Phillosiphy in the Flesh: The Embodied Mind and its Change to Western Thought. Basic Books, New York.

Larrain, Alina Álvarez and Michael K. McCall
2018 Participatory Mapping and Participatory GIS for Historical and Archaeological Landscape Studies: a Critical Review. *Journal of Archaeological Method and Theory* 26:643-678 https://doi.org/10.1007/s10816-018-9385-z.

Laughlin, Charles D. and Adam J. Rock
2013 Neuropohenomenology: Enhancing the Experimental and Cross-Cultural Study of Brain and Experience. The *Wiley-Blackwell Handbook of Transpersonal Psychology* 14:261-280.

Lee, Quao and Han
2017 GIS in Linguistic Research: a Chapter In *Comprehensive Geographic Information Systems,* Elsevier, Amsterdam. Edited by Huang, Bo, Thomas J. Cova, and Ming-Hsiang Tsou.

Lekson, Stephen H.
1996 Landscape with Ruins: archaeological Approaches to Built and Unbuilt Environments. *Journal of Current Anthropology* 37(5):886-892, University of Chicago Press. https://www.jstor.org/stable/2744429.

Lengen, Charis and Thomas Kistemann
2012 Sense of Place and Place Identity: Review of Neuroscientific Evidence. *Journal of Health and Place,* Elsevier. doi:10.1016/j.healthplace.2012.01.012

Leonard, Kelsey
2021 Putting Indigenous Place-Names and Languages Back on Maps. Esri, 2021: winter.

Lestrade, Sander
2017 Unzipping Zipf's Law. PLoS ONE, The University of Memphis.

Louis, Renee Pualani

2011 Hawaiian Storied Place Names: Re-placing Cultural Meaning. In *Landscape in Language: Transdisciplinary Perspectives* edited by David M. Mark, Andrew G. Turk, Niclas Burenhult, and Dr. David Stea, pp. 167-186. John Benjamins Publishing Company, Amsterdam.

Louwerse, Max M.
2008 Embodied Relations are Encoded in Language. *Psychonomic Bulletin and Review* 15(4): 838-844. University of Memphis, Memphis, TN.

Louwerse, Max M. and Nick Benesh
2012 Representing Spatial Structure Through Maps and Language: Lord of the Rings Encodes the Spatial Structure of Middle Earth. In *Cognitive Science: A Multidisciplinary Journal* 36:1556-1569.

Louwerse, Max M. and Sterling Hutchinson
2012 Neurological Evidence Linguistic Processes Precede Perceptual Simulation in Conceptual Processing. *Frontiers in Psychology* 3(385) edited by Louise Connell. University of Memphis, Memphis, TN.

Low, Setha
2017 *Spatializing culture: The Ethnophysiography of Space and Place*. Routledge Taylor and Francis Group, London.

MacDonald, Douglas H.
2012 *Montana Before History: 11,000 Years of Hunter-Gatherers in the Rockies and Plains.* Mountain Press Publishing Company, Missoula.

Majid, Asifa, Melissa Bowerman, Sotaro Kita, Daniel B.M. Haun, and Stephen C. Levinson
2004 Can Language Restructure Cognition? The Case for Space. *Trends in Cognitive Sciences* 8(3):108-114.

Malouf, Carling
1952 *Economy and Land Use by the Indians of Western Montana, USA*. University of Montana, Special Collections, Missoula.
1960 A Brief Inventory of Specimens and Features of Montana Prehistory, Archaeology in Montana 2(2):3-18, Archaeological Society of Montana, Bozeman.
1961 A Short History of Montana Archaeology, Archaeology in Montana 3(2):1-12, Archaeological Society of Montana, Bozeman.
1962 A Western Montana Mystery Object. Archaeology in Montana 4(3):9-12. A Short History of Montana Archaeology, Bozeman.

Manley, Will, Katharine Foot, and Andrew Davis
2019 *A Dictionary of Agriculture and Land Management*, Oxford University Press.

Mark, David and Andrew Turk
2003 Landscape Categories in Yindjibarndi: Ontology, Environment, and Language. *Lecture Notes in Computer Science* 2825: 28-45.

Mark, David, Andrew Turk, Niclas Burenhult, and David Stea

2011 *Language and Landscape: Transdisciplinary Perspectives*. John Benjamins Publishing Company, Amsterdam. ProQuest Ebook Central. https://ebookcentral-proquest-com.weblib.lib.umt.edu:2443/lib/msoumt/detail.action?docID=711406.

Martina, Henzi
2017 Mapping and GIS Analysis of Place Names Along the Sonora Coast in Mexico. Master's thesis, Department of Geography, University of Zurich. https://www.geo.uzh.ch/dam/jcr:44faf4ce-e5fd-4d6a-ad2c87bd1584b3a0/Master_Thesis_Martina_Henzi_2017.pdf.

Mayhew, Susan
2015 *A Dictionary of Geography* 5th ed, Oxford University Press.

McArthur, Tom, Jacqueline, Lam-McArthur, and Lise Fontaine
2018 *The Oxford Companion to the English Language* 2nd ed. Oxford University Press.

McDonald, Maryon
2018 From 'the body' to 'embodiment' with Help from Phenomenology. In *Schools and Styles of Anthropological Theory* edited by Matei Candea, pp. 185-194. Routledge, London.

Merleau-Ponty, Maurice
2012[1962] *Phenomenology of Perception*. Routledge Taylor and Francis Group, London.

Miller, Katie
2021 Missoula County is Continuing a Trend of Marking Native American Heritage, Missoula. KPAX news. https://www.kpax.com/news/western-montana-news/missoula-co-continuing-trend-of-marking-native-american-heritage

Missoula County Community and Planning Services
2019 *Missoula Area Land Use Element*, Missoula.

Monmonier, Mark
2006 *From Squaw Tit to Whorehouse Meadow: How Maps Name, Claim, and Inflame*. University of Chicago Press, Chicago.

Montaigne, Fen
2020 The Fertile Shore. Smithsonian Magazine. https://www.smithsonianmag.com/science-nature/how-humans-came-to-americas-180973739/.

Moss, Jessica M.
2018 Educational Experience of Virtual Reality: An Archaeological Case Study of the Maya Site, Vista Alegre. Master's thesis, Department of Anthropology, Georgia State University. https://scholarworks.gsu.edu/anthro_theses/138

Newman, MEJ
2005 Power Laws, Pareto Distributions and Zipf's Law. *Contemporary Physcis* 4(5):232-352.

O'Connor, Loretta and Peter C. Kroefges
2008 The Land Remembers: Landscape Terms and Place Names in Lowland Chontal of Oaxaca, Mexico. *Langugae Science* 30:291-315.

Omundson, Don Bert
1961 "Study of Place Names in Missoula County, Montana". Master's thesis, Department of English, University of Montana. https://scholarworks.umt.edu/etd/3727.

Pantadosi, Steven T.
2014 Zipf's Word Frequency Law in Natural Language: A Critical Review and Future Directions. *Psychonomic Society*.

Pipitone, Kaitlin
2019 Mapping Ideologies: Place Names in Glacier National Park. Master's thesis, Department of Anthropology; Linguistics Project, University of Montana, Missoula.

Ram, Kalpana and Christopher Houston
2015 *Phenomenology in Anthropology: A Sense of Perspective.* Indiana University Press, Bloomington.

Redman, Charles L.
1999 *Human Impact on Ancient Environments*. University of Arizona Press, Tucson.

Relph, Edward
1976 *Place and Placelessness.* Pinon Limited, London.

Rennell, Rebecca
2012 Landscape, Experience and GIS: Exploring the Potential for Methodological Dialogue. *Journal of Archaeological Method and Theory* 19:510-525.

Rogers, Alisdair, Noel Castree, and Rob Kitchin
2013 *Oxford Dictionary of Human Geography*. Oxford University Press.

Rosenberg, Matt
2019 The Four Traditions of Geography: William Pattison's Precepts Attempt to Define the World in Which we Live. ThoughtCo. https://www.thoughtco.com/four-traditions-of-geography-1435583.

Rouse, L. Jesse
2018 Phenomenology and Geographic Information Science: Experiencing Landscape Through Geospatial Technologies and Higuchi-style Indices. PhD. Dissertation, Department of Geography, West Virginia University.

Ryan, Ethan
2018 Chipping Through Time: The Evolution of Lithic Spatial Organization at the Bridge River Pithouse Village, British Columbia. Master's thesis, Department of Anthropology, University of Montana, Missoula.

Salish-Pend d'Oreille Cultural Committee and Elders Cultural Advisory Council Confederated Salish and Kootenai Tribes
2018 [2005] *The Salish People and the Lewis and Clark Expedition*. University of Nebraska Press, Lincoln. 2018 revised ed.

Sauer, Carl

1939 *Man in Nature: America Before the Days of the White Men*. Charles Scribner's Sons, New York.
1963 *Land and Life.* The University of California Press, Berkeley.

Sletto, Bjørn
2009 Special Issue: Indigenous Cartographies. *Journal of Cultural Geographies* 16:147-152. https://doi.org/10.1177/1474474008101514.

Sohl, Terry
2019 Land Use Land Cover Modeling. USGS. https://www.usgs.gov/core-science-systems/eros/lulc.

Smith, David Woodruff
2003 Phenomenology. *The Stanford Encyclopedia of Philosophy*.

Sousa, Arturo and Pablo García-Murillo
2001 Can Place Names be Used as Indicators of Landscape Changes? Application to the Donana Natural Park (Spain). *Landscape Ecology* 16:391-406.

Stewart, George R.
1945 *Names on the Land: A Historical Account of Place Naming in the United States*. Random House, New York.
2013[1954] A Classification of Place Names, *Names.* Journal of Onomastics. 2(1):1-13. https://doi.org/10.1179/nam.1954.2.1.1

Teeraranarat, Sirivilai and Kalaya Tingsabadh
2011 Using GIS for Linguistic Study: a Case of Dialect Change in the Northeastern Region of Thailand. *Procedia Social and Behavioral Sciences* 21:362-371.

Tent, Jan
2015 Approaches to Research in Toponymy. *A Journal of Onomastics* 63(2):65-74.

Thornton, Thomas F.
1997 Anthropological Studies of Native American Place Naming. *American Indian Quarterly* 21(2):209-228.

Throop, C. Jason
2015 Sacred Suffering: A Phenomenological Anthropological Perspective. In *Phenomenology in Anthropology: A Sense of Perspecitve,* edited by Christopher Houston and Kalpana Ram, pp. 331. Indiana University Press, Bloomington.

Thwaites, Reuben Gold (editor)
1905[1805] *Original Journals of the Lewis and Clark Expedition 1804-1806.* Arono Press, New York.

Tilley, Christopher and Kate Cameron-Daum
2017 *Anthropology of Landscape: The Extraordinary in the Ordinary*. UCL Press, London.

Tilley, Christopher
1994 *A Phenomenology of Landscape: Places, Paths, and Monuments*. Berg, Oxford.

ISBN 1859730760.

Toadvine, Ted
2016 Maurice Merleau-Ponty. *The Stanford Encyclopedia of Philosophy*. <https://plato.stanford.edu/archives/spr2019/entries/merleau-ponty/>

Tromp, Johanne, David Peeters, Antje S. Meyer, and Peter Hagoort
2017 The Combined use of Virtual Reality and EEG to Study Language Processing in Naturalistic Environments. SpringerLink 50:862-869.

Tuan, Yi-Fu
1977 *Space and Place*. University of Minnesota Press, Minneapolis.

Turk, Andrew and David Stea
2014 David Mark's Contribution to Ethnophysiography Research. *International Journal of Geographical Information Science* 28:1246-1263.

Turner, Nancy J.
2014 *Ancient Pathways Ancestral Knowledge: Ethnobotany and Ecological Wisdom of Indigenous Peoples of Northwestern North America*. McGill-Queen's University Press, Montreal 1.

US Department of the Interior
2012 National Register of Historic Places- Traditional Cultural Properties (TCPs): A Quick Guide for Preserving Native American Cultural Resources. National Park Service and American Indian Liaison Office. https://www.nps.gov/history/TRIBES/Documents/TCP.pdf.

Villette, Julia and Ross S. Purves
2018 Exploring Microtoponyms Through Linguistic and Geographic Perspectives. AGILE, Lund. https://agileonline.org/conference_paper/cds/agile_2018/shortpapers/67%20AGILE_2018_Villette_Purves.pdf.
2020 From Microtoponyms to Landscape Using Semantics, Location, and Topography: the Case of *Wald, Holz, Riet*, and *Moos* in St. Gallen, Switzerland. *The Professional Geogrpaher*.

Vivanco, Luis A.
2018 *A Dictionary of Cultural Anthropology*, Oxford University Press.

Wolf, Werner
2008 The Emergence of Experiential Iconicity and Spatial Perspective in Landscape Descriptions in English Fiction. *Motivated Sign*, edited by Olga Fischer and Max Nanny, John Benjamins Publishing Company. Amsterdam.

Yeginbayeva, Aygul, Kuat Saparov, Emin Atasoy, Alaattin Kizilçaoğlu, Jan A. Wendt
2016 The Role of GIS Mapping Method in Toponymy Research. Uludağ Üniversitesi Fen Edebiyat Fakültesi Sosyal Bilimler Dergisi. DOI: 10.21550/sosbilder.290455

Young, Ed

2018 “The Extremely Fast Peopling of the Americas”. The Atlantic. https://www.theatlantic.com/science/archive/2018/11/what-happened-after-people-first-arrived-americas/575335/

Zhang, Chaozhi, Dogan Gursoy, Zeng Deng, and Jun Gao
2014 Impact of Culture on Perceptions of Landscape Names, *Tourism Geographies: An International Journal of Tourism Space, Place and Environment* 17(1):134-150.

Zube, Ervin H.
1976 Perception of Landscape and Land Use. *Human Behavior and Environment,* Plenum Press, New York 3.

Zwaan, Rolf A. and Richard H. Yaxley
2003 Spatial Iconicity Affects Semantic Relatedness Judgments. *Psychonomic Bulletin and Review* 10(4):954-958.

Zeini, Nahed T.
2018 An Exploratory Study of Place-Names in Sinai Peninsula, Egypt: A Spatial Approach. *Annals of GIS* 24(3) 177-194.