SPATIAL AND TEMPORAL GROWTH ANALYSIS OF GEOGRAPHY-BASED ACADEMIC FEMALE GEOMORPHOLOGISTS IN THE UNITED STATES

by

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DEDICATION

For Amelia Chaewon Min. I love you mini-me.

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I would like to thank my mentor, advisor, and committee chair Dr. David R. Butler for never losing faith in me and always encouraging me to keep on going even when I feel like I can no longer continue my studies. Nobody better than him knows the struggles I went through in the time period it took me to complete this degree. I owe a lot to him.

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LIST OF ABBREVIATIONS

Abbreviation	Description
AAG	American Association of Geographers
CSWG	Committee on the Status of Women in Geography
GIS	Geographic Information Science
STEM	Science, Technology, Engineering, and Mathematics
U.K.	United Kingdom
U.S.	United States

I. INTRODUCTION

Since the beginning of geography as an academic discipline in the late 19th century, women have not been equally represented (Dunbar, 2001). Since then and even now in the 21st century, women have been seen as part of the reproductive labor which contributes to social and economic life. Society believed, and to some extent continues to believe, that women should stay home and take care of their family. Some question women's capability of having a strong demeanor and of being capable to conduct original research and contribute to the body of knowledge. Some even question their capability of being able to be a parent and/or a partner and still be able to maintain a full time job without letting these "external influences" affect the quality of their work (Zelinsky, 1973a).

Regardless of these beliefs, some people have expressed the need to incorporate women into geographical research (Zelinsky, 1973b; Rubin, 1979; Lee, 1990; Madge and Bee, 1999: Winkler, 2000; Thornbush, 2016). Not just to try to understand women as beings in place and time, but also to have women and accept women as conductors and producers of original research and contributors of new knowledge from a feminine perspective. What began as a study of that status of women in geography in the 1970s, has become today, an important aspect to explore and understand (Zelinsky, 1973b). The initial results of these studies were not very promising. They showed women participation in geography but the numbers were very low (Rubin, 1979). Subsequent studies showed an increase in participation but in a very minimal amount (Lee, 1990). In studies made in more recent years we still see the same pattern of low representation in

academia even though the number of women seeking degrees in geography has increased at a positive rate (Kaplan and Mapes, 2015).

All the studies have in common hat something more needs to be done to be able to reach gender equality in academic geography. This ideology allowed for feminist geography (and geographers) to further develop and bring attention to women in geography. They played an important role in ensuring that business and educational institutions took “affirmative action” in employing women (among other groups or minorities that had been historically excluded or underrepresented) (Rubin, 1979). These types of movements gave women the opportunity to increase their participation and contributions to the discipline. In an effort to further understand the place of women within geography, researchers have subsequently examined their representation by studying different topics such as their experiences of being a woman in geography (Sack, 2004); the number of students in geography and the levels of degrees awarded (Golledge and Halperin, 1983); the number of PhD degrees awarded compared to the actual numbers of women in academic and non-academic jobs (Kaplan and Mapes, 2015); the academic ranks of female faculty; and the status of women in the sub-discipline of physical geography (Madge and Bee, 1999; Luzzadder-Beach and Macfarlane, 2000). Therefore, the intent of this thesis is to further break down the sub-discipline of physical geography and focus specifically on the sub-field of geomorphology. This thesis seeks to distinguish what kind of changes have been experienced within the last 41 years for geography-based academic female geomorphologists in the United States (U.S.). Doing temporal and spatial analysis will show the trends of growth and the regions in which this growth is more prominent.

This thesis will bring light to the current state of geography-based academic female geomorphologists in the U.S. Additionally, it will serve as an example for others to conduct more specific studies among the other sub-fields in geography. I hope that the results serve as encouragement to other women to feel the need to continue being integrated in academia and carrying out scholarly careers against all odds.

Purpose Statement

Since the 1970s many academic articles in geography have been published expressing the need to increase the participation of women in physical geography. Women who will be part of the closure of the gender gap in academia, will also serve as supporters and mentors to other women seeking degrees in physical geography in the U.S. (Zelinsky, 1973a; 1973b; Lee, 1990; Madge and Bee, 1999; Luzzadder-Beach and Macfarlane, 2000; Winkler, 2000; Schlemper and Monk, 2011, Kaplan and Mapes, 2015). Therefore, the purpose of this thesis is to identify what progress has been made in the sub-discipline of physical geography, specifically in the sub-field of geomorphology.

In 1995 faculty listing geomorphology as a specialty in physical geography, ranked as #1 among men and #3 among women but this data could not be compared to previous data because it did not exist (Luzzadder-Beach and Macfarlane, 2000). As a result, this thesis looks at data collected from the American Association of Geographers' (AAG) *Guide to Geography Programs in the Americas* (previously titled *Guide to Programs in Geography in the United States and Canada*) for the years 1973, 1980, 1990, 2000, 2010, and 2014. A statistical temporal analysis of the last 41 years shows what the progress has been and the current state of women representation as faculty members in geography-based geomorphology. It also shows how it compares to the

growth and current state of men in the same sub-field. Using Geographic Information Science (GIS), a spatial analysis provides an illustration of the distribution trends within the AAG's 9 regional divisions. Ultimately, this thesis serves as a complete and current census of female faculty representation in geography-based geomorphology. This thesis is not intended to address issues associated with feminist theory. This thesis is only intended to provide an updated and current state of women representation in physical geography, specifically geomorphology.

Objective

Several studies that have been done since the early 1970s explore the growth of women in geography. Many look at geography as a whole discipline (Zelinsky, 1973a; 1973b; Rubin, 1979; Lee, 1990; Falconer Al-Hindi, 2000; Brinegar, 2001; Monk, 2006; Schlemper and Monk, 2011, Kaplan and Mapes, 2015). Some focus on the sub-discipline of physical geography (Madge and Bee, 1999; Luzzadder-Beach and Macfarlane, 2000). They all comment on the lack of representation by women and the need for mentors in order to decrease the gender gap. Therefore, the main objective of this thesis is to answer the following questions:

1. How has the representation of geography-based academic female geomorphologists in the United States changed over the past 41 years?

2. What trends in spatial distribution can be observed through a GIS analysis?

To answer these questions a simple conceptual framework (Figure 1) illustrates the process in which data was collected, analyzed, and interpreted.

By meeting this objective the results provide a complete and current census of geography-based academic female geomorphologists in the U.S. It also provides a clear

representation of whether a gender gap still exists, and if so, the severity of that gap. Additionally, it also provides data that can serve as a source for the further integration of women in events that are scholarly in nature.

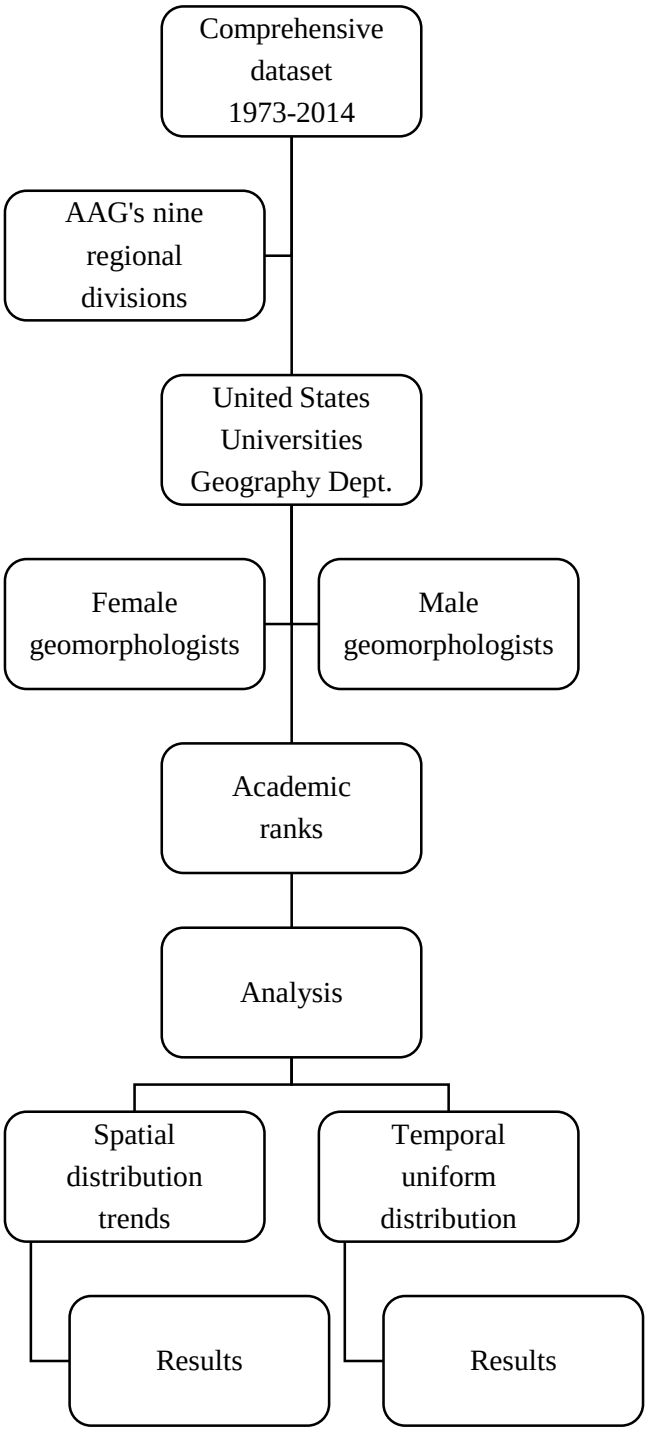

Figure 1. Conceptual framework

II. LITERATURE REVIEW

> "It is not our desire to change needle and thread in women's hands into astrolabes and globes; neither do we consider it necessary that a woman should retreat to a room papered with maps and ornamented with globes . . . Their high moral standards allow them, in our view, to possess wide knowledge of geography, on condition that they do not attempt, through use of terms too coarse for a lady, to appear too eager a group of geographers. I am certainly willing to let them use such words as climate, zones, and so forth; but I do not want them to scare me stiff quoting longitude and latitude at me. Let them speak as much as they want about what they read in travelers' tales, and I will listen with pleasure . . . But I certainly do not want to see the day when a woman's knowledge of the earth equals that of men!" (M. de Vaumoriere, 1701, p. 319-320 as cited in Zelinsky, 1973a)

This is how Wilbur Zelinsky, a past president of the AAG in 1972-73, begins one of his several academic articles that addresses the state of women in geography (Zelinsky, 1973a). He was the only president of the AAG who publicly expressed a concern with the issue at hand as of the 1970s. He based his concern on a study that he published in that same issue of *The Professional Geographer* in 1973. He did a statistical analysis on material from the AAG's guides which contained the grand majority of practicing professional geographers in the U.S. The study showed that in 1971-72 women members of the AAG only held 3.1% of the faculty positions in the 114 major geography departments in the U.S. (Zelinsky, 1973b). The purpose of his study was to "provide the background for constructive programs to correct an unhappy situation" (Zelinsky, 1973a). Since then, his study has become a platform for further research of the status of women in geography.

Barbara Rubin (1979) revisited the status of women in geography following Zelinsky's study from 1973, the passage of the Civil Rights Act in 1964, and the passage of Title IX of the Education Amendment in 1972. She found that although several other

disciplines had taken positive steps in monitoring affirmative action and the implementation of equal employment opportunity for women and other minorities, the AAG's lack of action left much to be desired. In 1971, the AAG formed a Committee on the Status of Women in Geography (CSWG). However, it was not until 1977 that CSWG was approved as a standing committee. And so, their actions proved to Rubin that the AAG "had been either unable or unwilling to assume leadership in ending the traditional pattern of sex discrimination that has characterized academic geography since its inception" (Rubin, 1979, p. 133). At the time in which the article was written it seemed as a still "unhappy situation" as she challenged the association with little success.

Reginald G. Golledge and William C. Halperin (1983) published On the Status of Women in Geography, an AAG departmental survey which provided "self-explanatory" (Golledge and William, 1983, p. 214) tables to indicate the percentages of female geography students, the innovations by universities and departments to incorporate women and women studies into their programs and the perception of harassment and discrimination within geography departments, between the years 1976 and 1981. However, their sample only represented about 10 percent of all graduate programs in geography in North America.

David R. Lee (1990) published an article that revisited the situation yet again. He used similar methods and data to those used by Zelinsky (1973a), Rubin (1979), and Golledge and Halperin (1983). He found that by comparing figures from the 1980s to those from 1950-70, the percentage of women receiving degrees in geography had a highly significant increase. However, when compared to other social sciences the percentage was still smaller. His results also showed that the percentage of female faculty

was significantly higher at the lower ranks whereas it was significantly lower at the higher ranks. When compared with sociology, the percentage of female faculty at all ranks in geography was significantly lower. He also found that positions of leadership, such as Chairs of departments, were also unequally represented by gender, favoring males over females. He directed our attention to admitting that geography "suffers from an inability to recruit, train, and retain females in the profession to the same degree as males" because it is difficult for women to establish an effective mentoring relationship with their professors. He then again stressed the need to incorporate more women into the discipline.

Clare Madge and Anna Bee (1999) focused on women in scientific physical geography in the United Kingdom (U.K.), another part of the world that felt the need to address the underrepresentation of women in the discipline which reflected only 22 % of their academic staff. They conducted semi-structured in-depth interviews with female physical geographers in British universities. Like in previous results obtained from studies made in the U.S. they found that "gender does matter when considering a women's position and identity as a physical geographer" (Madge and Bee, 1999, p. 345). However, on a more positive ending, their commitment to their careers as physical geographers allowed them to succeed in entering academia and maintaining their place. They also touched on the importance of having the support of the academic community and the need of mentors to ensure equality in the discipline.

Back in the U.S., Sheryl Luzzadder-Beach and Allison Macfarlane (2000) were studying the Status and Perspectives of Women and Men in Physical Geography. Since the 1970s all of the studies had concentrated on the status of women in geography. There

are many sub-disciplines in geography that still needed to be explored and this type of research in physical geography had not been addressed. Through the use of confidential surveys Luzzadder-Beach and Macfarlane found that "there was a significantly larger proportion of women than men who were at the assistant professor rank, a significantly lower proportion of women than men at the full professor rank, and a less significant difference between women and men at the associate professor level" (Luzzadder-Beach and Macfarlane, 2000, p. 411) in physical geography. They further broke down the sub-discipline into 6 general subfields: climatology, biogeography, hydrology, geomorphology, pedology, and energy resources. They found that "of female respondents in physical geography, the three most representative topical proficiencies selected out of the list were biogeography (28%), climatology (19%), and geomorphology (19%)" (Luzzadder-Beach and Macfarlane, 2000, p. 414) whereas for men the results were different "though dominated by the same top three: geomorphology (35%), climatology (33%) and biogeography (21%)" (Luzzadder-Beach and Macfarlane, 2000, p. 415). Although the results still show the inequality in the discipline as far as gender representation and the need for more female mentors, this was the first time that the sub-discipline of physical geography had been broken down into specialty sub-fields. This study introduced the need to continue looking deeper into the different sub-fields within geography because there were obvious differences in sub-field specialties between the two genders.

Since then, a couple of studies on the status of geography-based geomorphologists (women and men) have been made. Dorothy Sack (2004) focused her paper on outstanding female geomorphologists. She tracked previous articles and books that

focused on female geomorphologists and wrote about the experiences of these women as scientists in the 20th century yet not on the status of female geomorphologists in the discipline of geography. Some qualities that described what it was like to be a woman with a career-oriented lifestyle in a heavily male dominated discipline were “tenacity, determination and a strong sense of self” (Sack, 2004, p. 450). The paper did not ignore the issues related to gender inequality, but instead it made it irrelevant in being a good geomorphologist and accomplishing their career goals.

More recently, Carol F. Sawyer, David R. Butler, and Tela O'Rourke (2014) focused their studies on a historical look at the Binghamton Geomorphology Symposium. They looked at the temporal and spatial changes that the symposium has experience over the years. Through their results they found that geomorphology experienced a shift from a geology-based to a geography-based subfield; as well as, an increase in interdisciplinary collaborations. Graduated symbol maps illustrated the increased diffusion of the symposium’s locations; and data analyzing citations and author contributions supported interdisciplinary collaborations. While gender ratios touched on that very common theme that we have seen through the notable articles already mentioned; a gender gap favoring men and unequal representation, steady and slow increase in women participation was observed.

However, none of these studies have looked at the spatial and temporal growth of geography-based academic female geomorphologists in the U.S., which is the intent of this thesis.

III. RESEARCH METHODS

In order to determine the growth of geography-based academic female geomorphologist in the U.S. a temporal and a spatial analysis of data collected from the AAG's *Guide to Geography Programs in the Americas* (previously titled *Guide to Programs in Geography in the United States and Canada*) was conducted. The AAG's Guide is updated every year and it provides the most complete list of universities in the U.S. and Canada that have a geography program or department in place. The Guide also lists the specialties of each faculty member that is part of the program.

The temporal analysis determined how many female faculty with a self-identified specialization in the sub-field of geomorphology were employed as faculty in the U.S. 1973 and 2014 are defined starting and ending points respectively based on availability, decadal years (1980, 1990, 2000, 2010) were also examined in order to illustrate trends over ten-year blocks of time. These dates provided a dataset for a total of 41 years. The same analysis was made for the male faculty. These results were then compared to each other to see the ratios in which change has occurred.

The spatial analysis determined which regional divisions in the U.S. (as determined by the AAG) show more upward trajectories in hiring female geomorphology faculty. GIS mapping of the universities employing female geography-based geomorphologists within each regional division was done. A map for each of the years previously mentioned was made. By placing the maps adjacent, cognitive comparisons were observed thus providing interpretations identifying similarities and differences between the genders within the regional divisions.

Site and Situation

The sites of interest are the universities located within any of the 50 states of the U.S. These universities are required to have a geography program or department in place at the time of data collection and be listed in the AAG's Guide. No other countries were considered as the study is specifically directed to female faculty in the U.S.

Data

The source of the data for this thesis is the AAG's published *Guide to Geography Programs in the Americas*. The years of interest are: 1973-74, 1980-81, 1990-91, 2000-01, 2010-11, and 2014-15. Although, the year 1970-71 would appear to be a more appropriate source for the purpose of this thesis, in 1970-71 the Guide only included the members of the AAG and not the list of universities with geography programs. Therefore, it did not meet the requirements needed for the purpose of this thesis. The data collected represents 41 years of information. For each of the years previously listed, both female and male faculty with a PhD and a specialty in the sub-field of geomorphology, as listed by the university, were selected. Hiring institution, location, gender, and academic rank were the considered variables.

The employing institution is the name of the university under which the faculty of interest is listed. The location was allocated by the State in which the university is located. The academic rank was determined as it is listed in the Guide. In some instances the academic rank was not provided. To determine the rank by other means, the instructor's Curriculum Vitae was consulted, when available, for the year in question. When the academic rank of the faculty member in question was not determined, the rank was recorded as "Not Listed". The primary ranks of interests are: Full Professor,

Associate Professor, Assistant Professor, and Lecturer or Instructor. Any other type of academic rank such as: Adjunct, Affiliate, Researcher, Visiting, or anything that does not fall under the 4 primary ranks previously mentioned was categorized under "Other". Gender was determined based on the individual's first name. In instances where gender was not easily identifiable by the first name a search within the website of the listed University was conducted. When the information was still not available, the Google search engine was used to find the listed individual and to establish his or her gender using images and personal pronouns. When gender was not determined by those means then gender for these individuals was labeled as "U" for unassigned.

Analysis

There were three types of temporal analysis that were done on the data collected from the Guides. The first analysis compared on Microsoft Excel the total female faculty versus the total male faculty, specializing in geomorphology, for each of the years of interest. This analysis provides the ratios of female to male for each year and combined an overall total summary. Using SPSS a second analysis was conducted on this data. A Chi-square test for uniformity was performed to determine if the values assigned to female and male faculty conform to a uniform distribution. Thirdly, using Microsoft Excel the academic rank dataset was analyzed and graphed to show how the ratios have changed over the 41 year span. ArcGIS 10.4 was used to analyze the spatial distribution of trends in the U.S. Each female geomorphologist was geocoded to their respective university using the state address locator, making the process as simple but effective as possible. A vector polygon shape file of the AAG's 9 regional divisions was created (Figure 2).

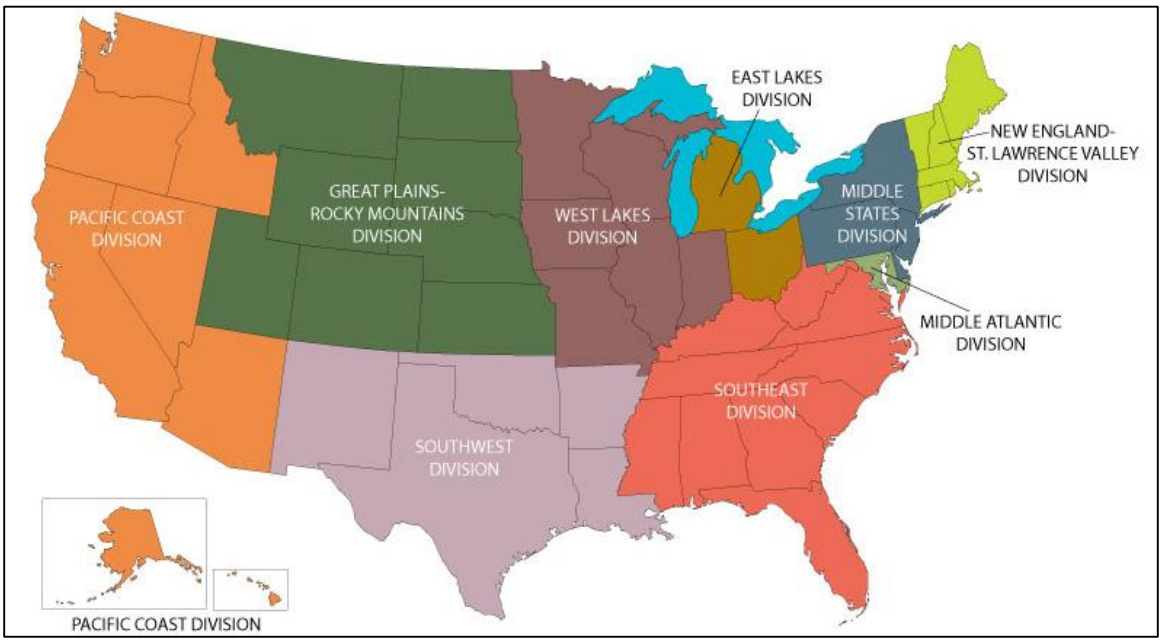

Figure 2. AAG's regional divisions. Source: http://www.aag.org/cs/membership/regional_divisions.

The divisions are grouped as follows:

- **East Lakes Division**: Michigan, and Ohio
- **Great Planes/Rocky Mountains**: Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah, and Wyoming
- **Middle Atlantic**: Maryland, Northern Virginia, and the District of Columbia
- **Middle States**: Delaware, New Jersey, New York, and Pennsylvania
- **New England/St. Lawrence Valley**: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
- **Pacific Coast**: Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, and Washington

- **Southeast**: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia
- **Southwest**: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas
- **West Lakes**: Illinois, Indiana, Iowa, Minnesota, Missouri, and Wisconsin

A spatial join of the geocoded female geomorphologists to the AAG's boundary polygon was conducted and to provide a summarized number of entries per AAG regional division. This was also done for each of the 6 years that represent 41 years of data. The data is displayed as a graduated symbol map based on the number of female geomorphologists per region and as pie charts displaying of all of the regions for the 41 years.

Limitations

Out of the 998 total faculty members teaching geography-based geomorphology in U.S. universities, only two members were assigned with "U" for unassigned gender. Therefore, they were removed and not considered for analysis as they only represent a very small percentage of the data. As previously mentioned, the Guide for the year 1970-71 only includes the members of the AAG and not the list of universities with geography programs. Therefore, the earliest copy of the Guide that was obtainable and included a list of universities with geography programs, was for the year of 1973-74. Not all of the universities listed the faculties' specialty. Therefore, some faculty who actually specialize in geomorphology might have been overlooked. In order to be consistent with the data gathering, those who did not have a specialty listed were not included as part of the final data. In other cases, the universities did not list the rank of the faculty. Therefore, some faculty have been overlooked as well.

IV. RESULTS

Temporal Results

As predicted, the results confirm that there is still a gender gap within faculty specializing in geography-based geomorphology in the U.S. (Table 1). However, positive growth trends are observed. In 1973 only 1.33% of the faculty were female versus 98.67% who were male (1 female, 74 males). The most current data in 2014 shows female faculty as 17% and male faculty as 83% (34 female, 166 male).

Table 1. Ratios of geography-based geomorphology faculty in the U.S. based on gender, 1973-2014.

Year	Female Faculty	Male Faculty	Total Faculty
1973	1	74	75
	1.33%	**98.67%**	**100.00%**
1980	3	102	105
	2.86%	**97.14%**	**100.00%**
1990	10	165	175
	5.71%	**94.29%**	**100.00%**
2000	29	189	218
	13.30%	**86.70%**	**100.00%**
2010	39	184	223
	17.49%	**82.51%**	**100.00%**
2014	34	166	200
	17.00%	**83.00%**	**100.00%**
41 Years	**116**	**880**	**996**
	11.65%	**88.35%**	**100.00%**

The most apparent change within female faculty is observed between the years 1990 and 2000 (Figure 3), when the percentage of female faculty climbed from 5.71% to 13.30%, respectively. However, the largest percentage of female faculty teaching geomorphology is observed in 2010 with 17.49%.

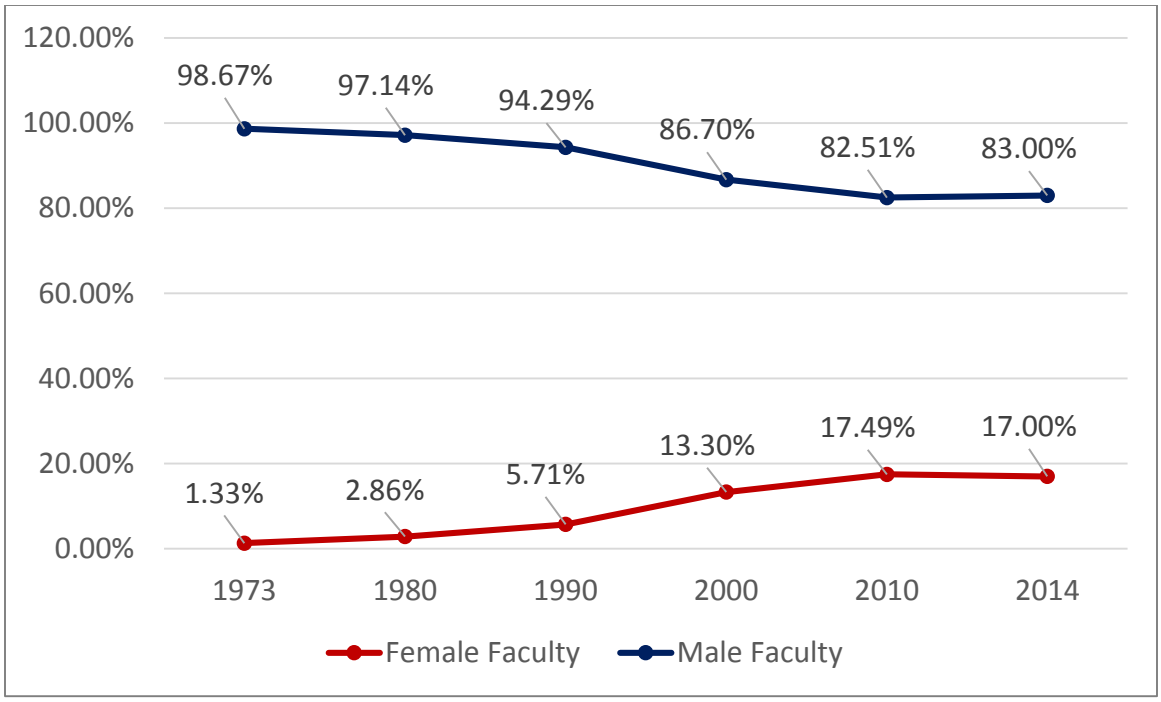

Figure 3. Ratios of geography-based geomorphology faculty in the U.S. based on gender, 1973-2014.

The Chi-square test for uniformity performed on the female and male counts for all of the 6 years, found in Table 1, tested the null hypothesis. The null hypothesis states that the distribution is uniform, meaning there is no change over time and the *p* values are larger than .05. The 6 separate outputs testing against a uniform distribution in one batch all have *p* values smaller than .05 thus rejecting the null hypothesis (Appendix A). This implies that improvement has been made over the years and women have been (slowly) gaining representation in geography-based geomorphology.

The analysis of the different academic ranks held by women versus men in the last 41 years (Table 2) shows both female and male faculty have held fewer positions as Lecturers or Instructors. However, within this specific category more women have held these positions. It is also observed that fewer women have held positions as Full

Professors and more positions as Assistant Professors. Men have held fewer positions as Assistant Professors and more positions as Full Professors.

Table 2. Academic ranks of geography-based geomorphology female and male faculty in the U.S, 1973-2014.

Year	Female Faculty						Male Faculty						Total Faculty
	Full Professor	Associate Professor	Assistant Professor	Instructor or Lecturer	Other	Total	Full Professor	Associate Professor	Assistant Professor	Instructor or Lecturer	Other	Total	
1973-74	1	----	----	----	----	1	26	22	17	2	7	74	75
1980-81	1	----	2	----	----	3	40	32	24	1	5	102	105
1990-91	1	1	7	----	1	10	62	51	36	----	16	165	175
2000-01	7	8	10	2	2	29	79	52	35	2	21	189	218
2010-11	11	11	11	----	6	39	72	53	30	----	29	184	223
2014-15	8	16	8	----	2	34	73	34	28	1	30	166	200
Total	29	36	38	2	11	116	352	244	170	6	108	880	996
	25.00%	**31.03%**	**32.76%**	**1.72%**	**9.48%**	**100.00%**	**40.00%**	**27.73%**	**19.32%**	**0.68%**	**12.27%**	**100.00%**	

Spatial Results

An initial analysis of the data on Microsoft Excel of the faculty count (Table 3) and the represented percentages (Figure 4), shows that in the 41 years being studied the AAG's Southeast division has hired more female faculty than any of the other regional division, 26 out of 116 (23%). This trend was followed by the Pacific Coast division, 22 out of 116 (19%) and the West Lakes division, 21 out of 116 (18%). On the opposite side of the spectrum, the Middle Atlantic Division had the lowest female faculty hiring trends 1 out of 116 (1%). This trend was followed by the East Lakes and New England/St. Lawrence Valley divisions, both with 5 out of 116 (4%).

Table 3. Count of AAG's regional divisions' female faculty hiring trends, 1973-2014.

REGIONAL DIVISIONS	1973	1980	1990	2000	2010	2014	41 Years
East Lakes	0	0	0	1	2	2	5
Great Plains/Rocky Mountains	0	0	1	1	7	8	17
Middle Atlantic	0	0	0	1	0	0	1
Middle States	0	0	0	4	4	4	12
New England/St. Lawrence Valley	0	1	0	2	2	0	5
Pacific Coast	0	1	3	9	6	3	22
Southeast	0	0	2	5	11	8	26
Southwest	0	0	0	2	1	4	7
West Lakes	1	1	4	4	6	5	21
Total	1	3	10	29	39	34	116

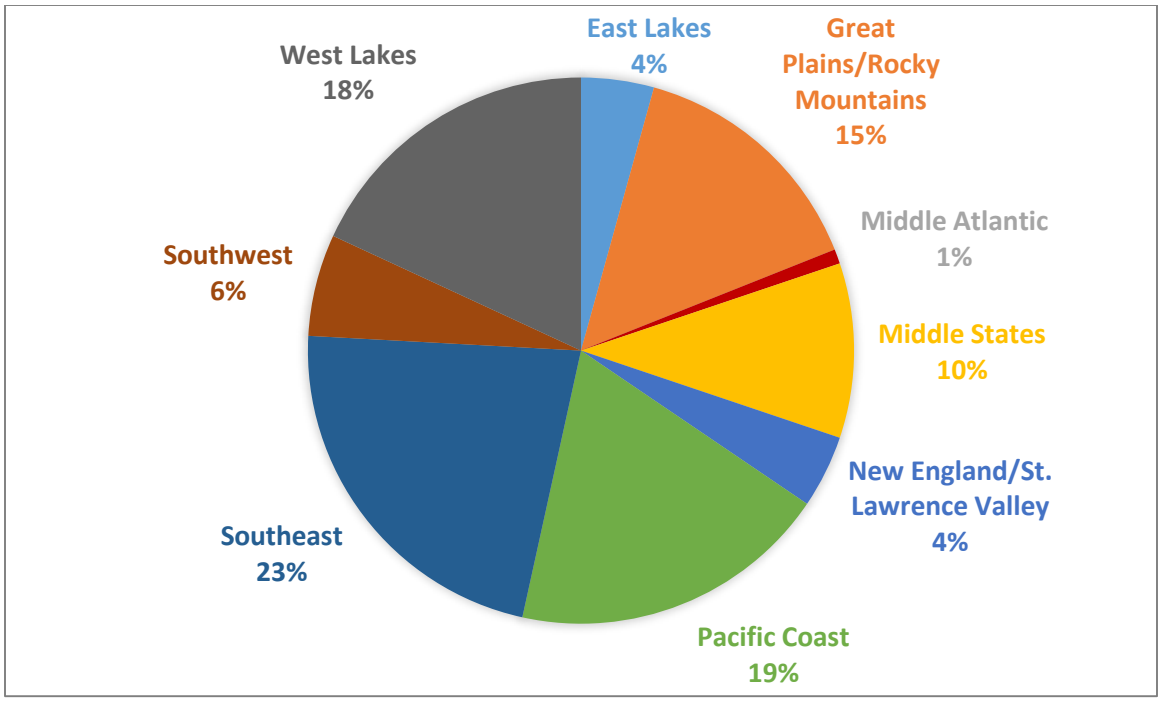

Figure 4. Percentage summary of AAG's regional divisions' female faculty hiring trends, 1973-2014.

The geographic information from Table 3 and Figure 4 allowed for the creation of a map (Figure 5) using ArcGIS 10. This map of the U.S. shows a summary of each division with its respective states and the hiring trends of geography-based female geomorphologists for the 41 years being analyzed. The map clearly mirrors the geographic information previously described. It is observed that although the Southeast division had the higher trends in hiring female faculty, the West Lakes division was the only region with female faculty in 1973. In 1990 the Southeast division first shows female faculty with a strong hiring trend from there on out. A series of individual maps for the regional divisions and each year 1973-1974 (Figure 6), 1980-1981 (Figure 7), 1990-1991 (Figure 8), 2000-2001 (Figure 9), 2010-2011 (Figure 10), and 2014-2015 (Figure 11) was also produced to show a percentage breakdown of the faculty counts.

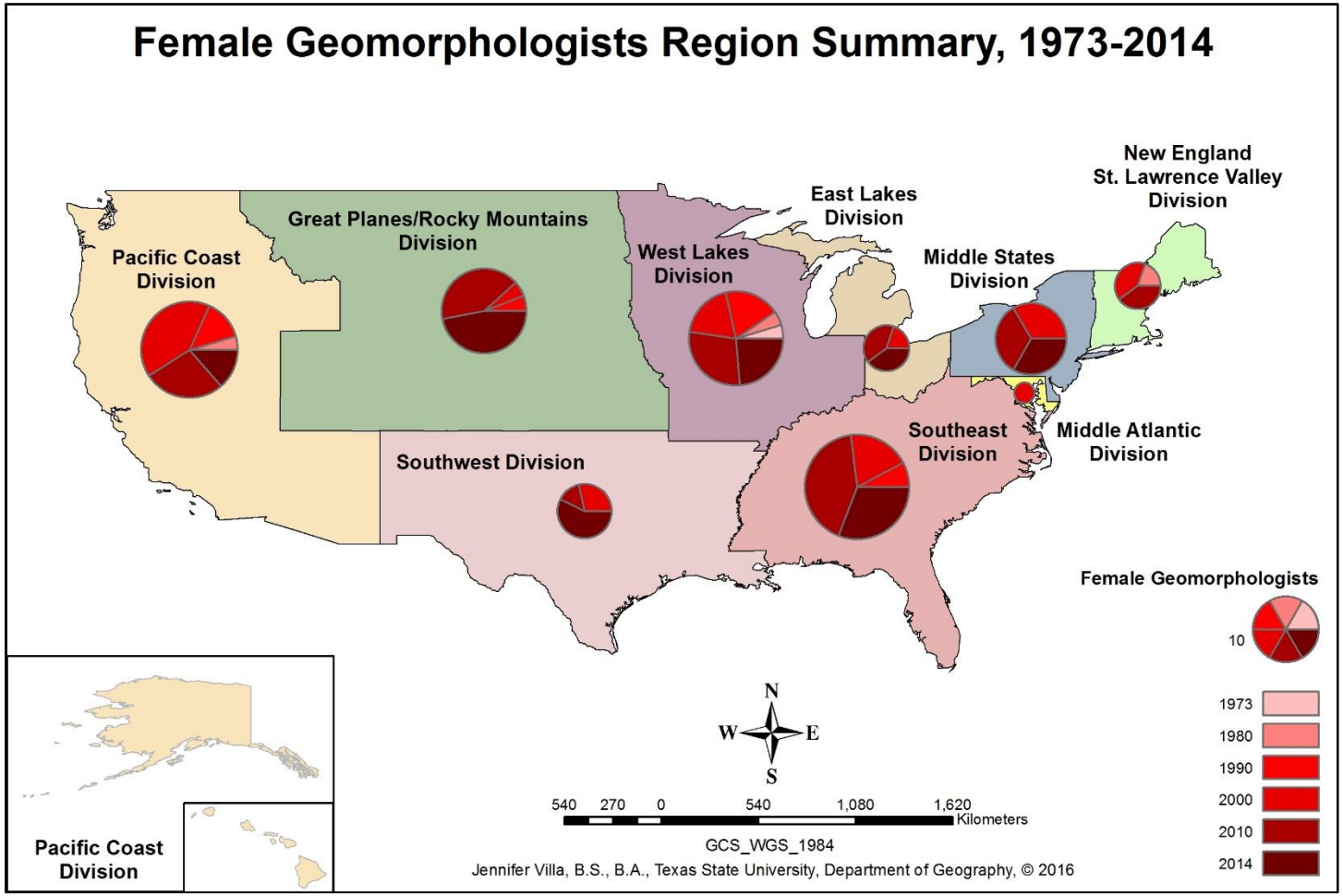

Figure 5. Graduated symbol map illustrating the AAG's 9 regional divisions and their hiring trends of Female geomorphologists, 1973-2014.

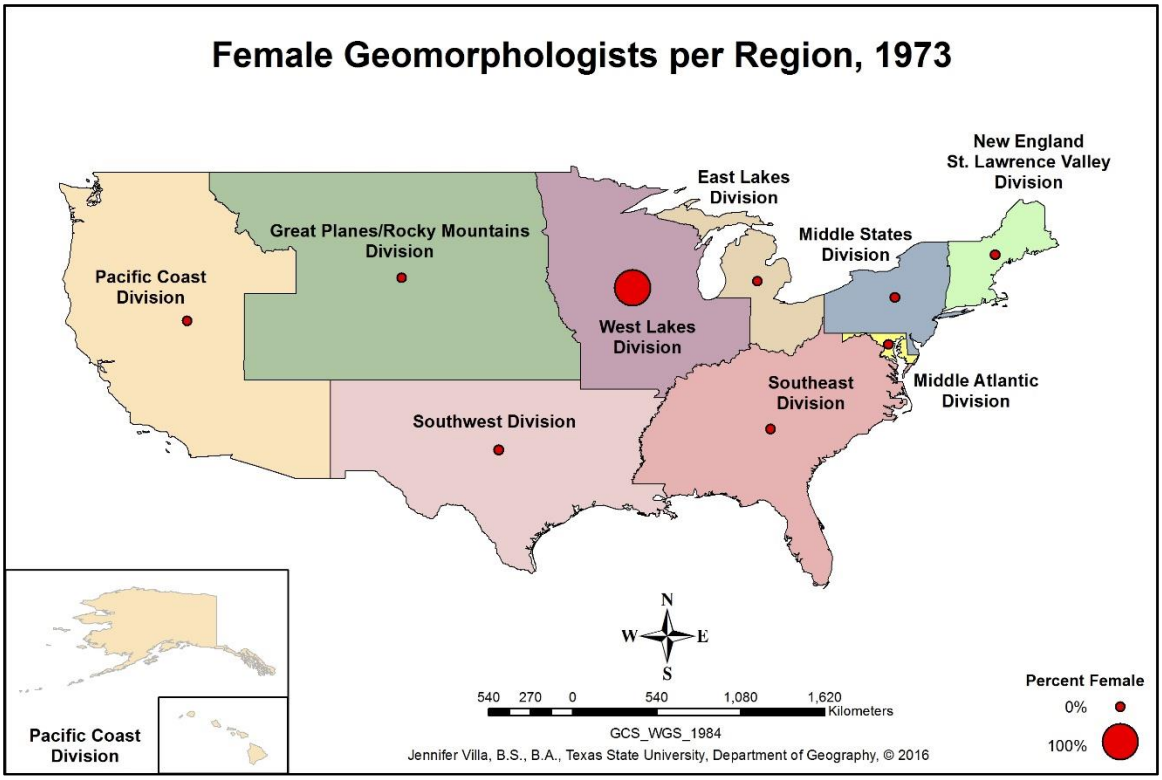

Figure 6. Percentage of female geomorphologists per regional division, 1973-74.

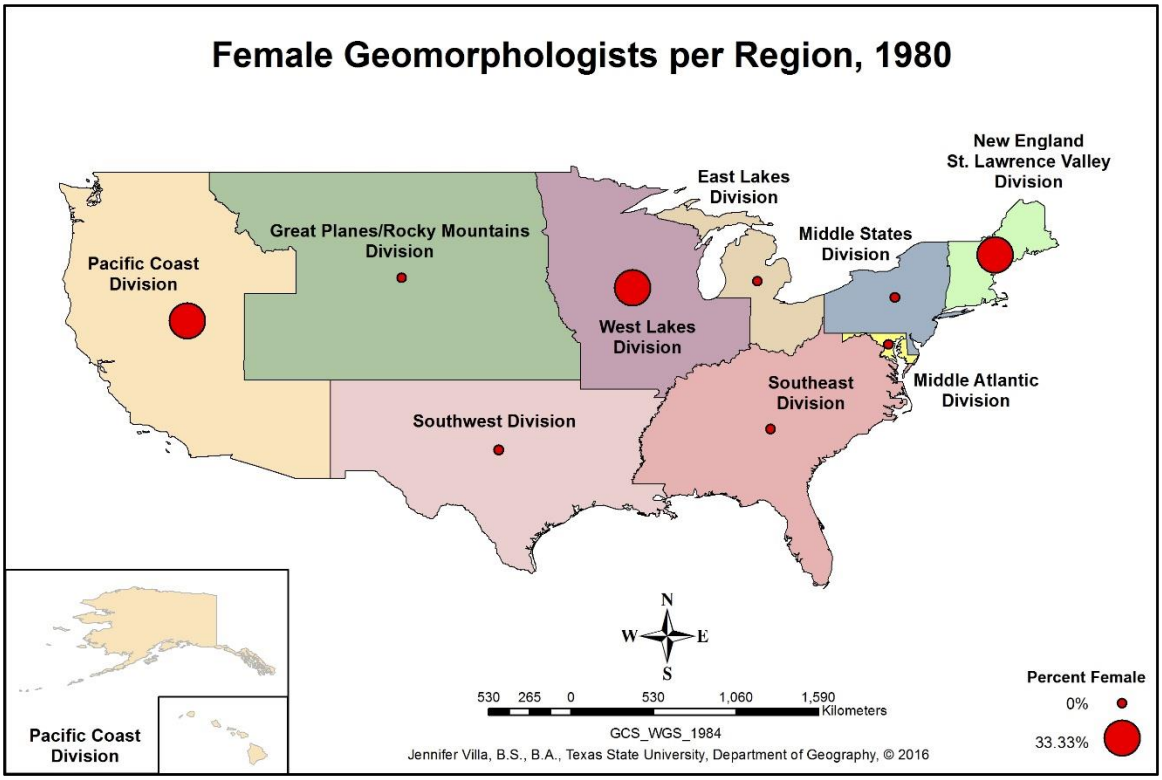

Figure 7. Percentage of female geomorphologists per regional division, 1980-81.

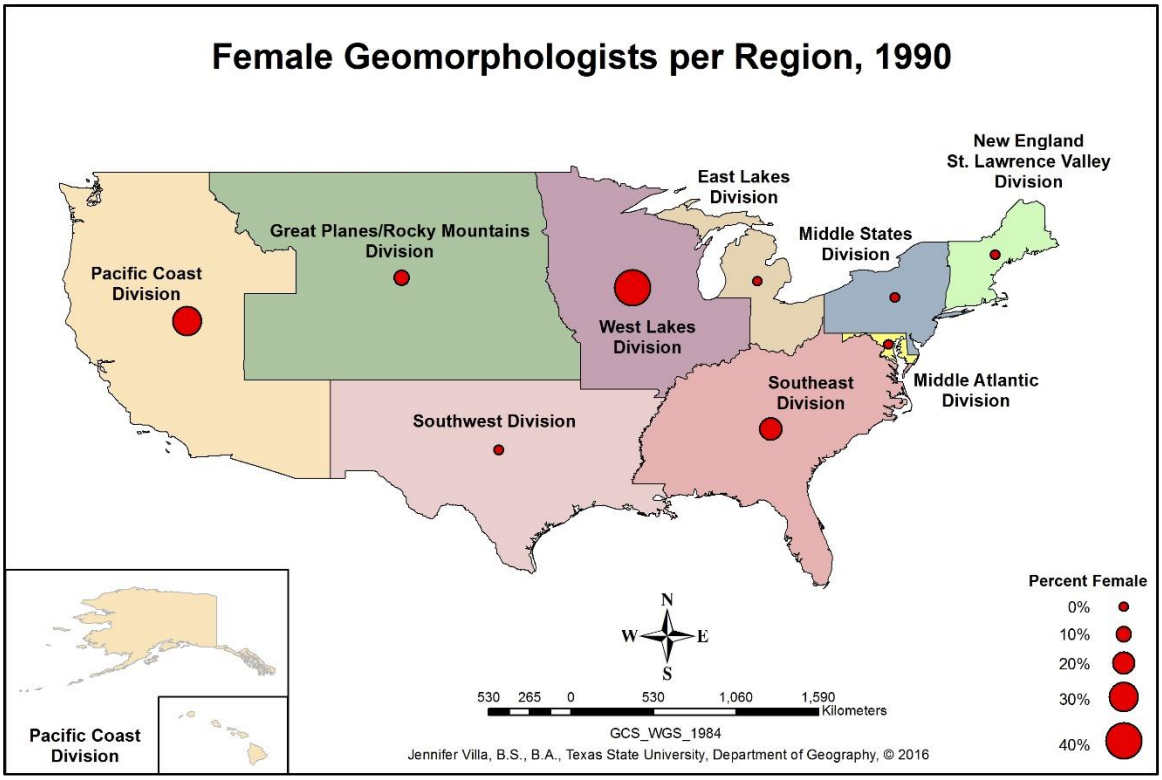

Figure 8. Percentage of female geomorphologists per regional division, 1990-91.

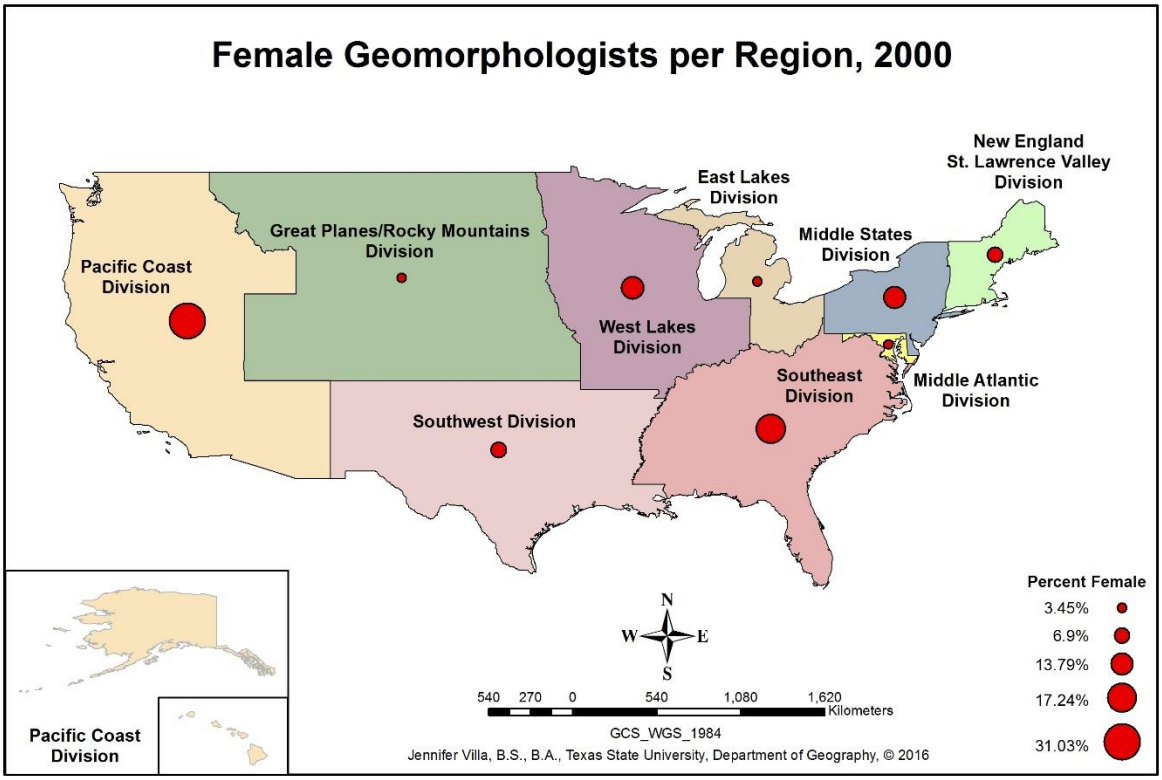

Figure 9. Percentage of female geomorphologists per regional division, 2000-01.

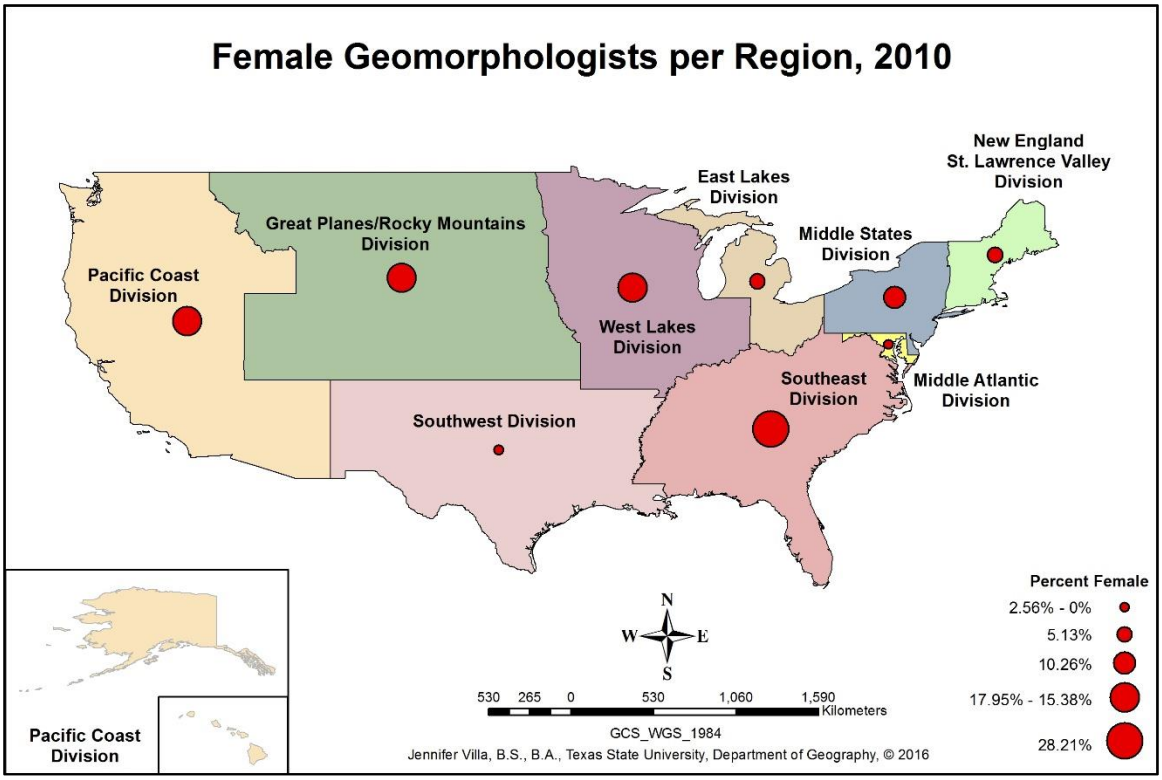

Figure 10. Percentage of female geomorphologists per regional division, 2010-11.

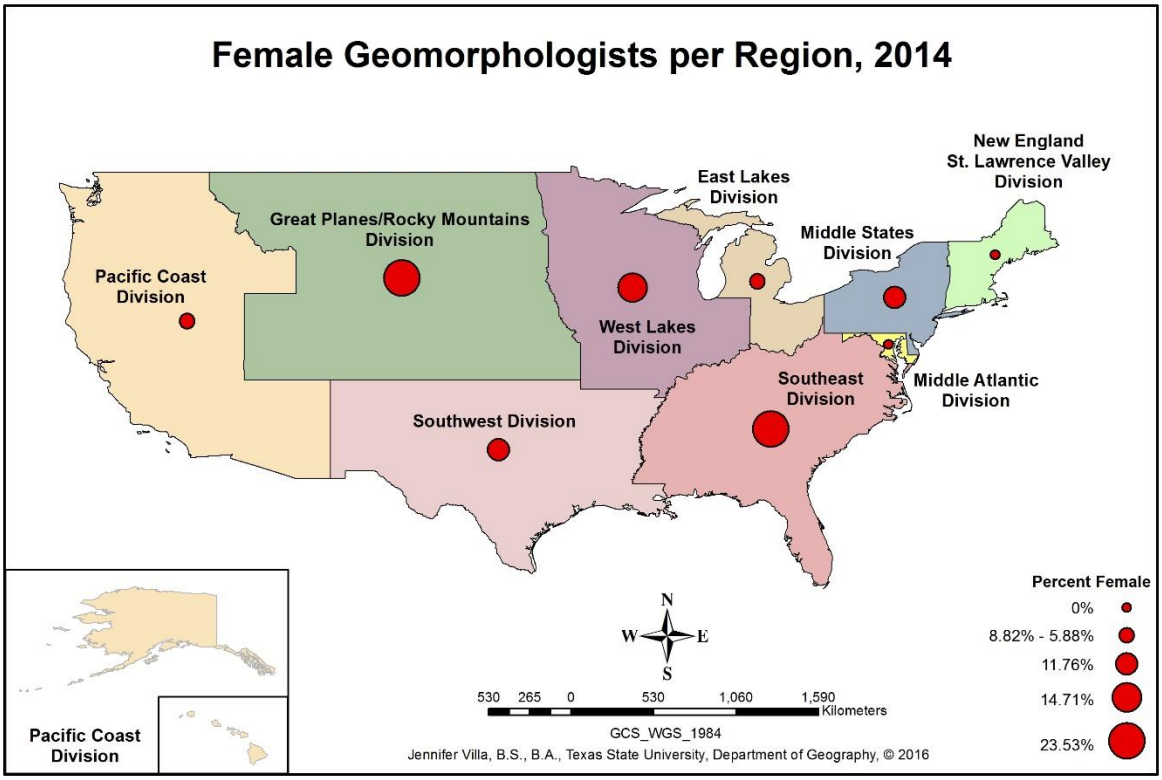

Figure 11. Percentage of female geomorphologists per regional division, 2014-15.

V. DISCUSSION

In spite of the improvement in the representation of female faculty in geography-based geomorphology, the temporal analysis shows that the progress is still very slow. In 1973, 1 out of 75 faculty members specializing in geomorphology was a woman (1.33% female, 98.67% male). The largest increase within female faculty that is observed between the years 1990 and 2000 could be credited to Rubin (1979), who pressured the AAG to be more proactive in implementing affirmative action on gender and other minority issues within academic geography. Because the data does not determine when the faculty was hired, but what position they held during the year of interest, it is uncertain to know when exactly they took a position as faculty. However, the process of becoming a PhD graduate can be quite strenuous and lengthy and vary from program to program, facilitating the change to be more apparent during the 1990s. Consequently these ratios influence the academic rank proportions between women and men; as men have had an advantageous head start in filling faculty positions. While the position as an Assistant Professor (32.76%) is the more prominent among women within the 41 years of data, the Associate Professor (31.03%) position closely follows behind, which could eventually lead to a Full Professor position. If academic geography continues to grow at the rate in which it has been growing over the past 41 years, it is going to take approximately 241 years to reach 100% gender equality. The growth patterns do, however, show that it is going to take some time to close the academic gap and to bring more equality to academic rank positions. Nevertheless, the prospective is good since the rate of female faculty is in fact growing.

The spatial analysis determined that the West Lakes division (Illinois, Indiana, Iowa, Minnesota, Missouri, and Wisconsin) was the first region to report a female faculty member who specializes in geography-based geomorphology. However, this division did not lead in hiring more female faculty over time. It was the Southeast division (Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia) that had lead by hiring more female faculty, 26 out of 116 (23%), in the 41 year span. This was followed by the Pacific Coast division (Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, and Washington) with 22 (19%) and the West Lakes division with 21 (18%). I cannot say for certain why this pattern is observed in these regions as it was not part of my research to answer that question. I can speculate that maybe more universities in those geographic regions have geography programs in place that specialize in geomorphology. This, however, presents itself as a great opportunity for further research.

Future Research

Because this study is the first of its kind, the data collected serves as a starting ground for further research not just on gender issues but also on the current state of academic geography-based geomorphology. Further research can be done on positions of leadership, such as Chairs of departments and what kind of temporal changes can be observed. Also, identifying key departments and/or key individuals who support the ideology of incorporating more women in the sub-field of geography-based geomorphology could draw some interesting observations and/or trends. It would also be interesting to see in what other source of employment we can find geomorphologists and what the gender ratios are in those industries as well. Since the rate of female faculty

showed a small drop between 2010 and 2014, it would be interesting to look further into the data and try to determine why this happened and if there are prospects of positive change. As previously mentioned, it would be interesting to answer the question of why certain regional divisions show more positive trends in hiring female faculty and how that varies in each state within the regional division. It is important to keep in mind that geomorphologists can be geography-based or geology based so two subfields could also be explored in the same manner.

VI. CONCLUSION

It is no surprise that since the beginning of geography as an academic discipline in the late 19th century, women have been under represented. However, it is surprising that it was not until the 1970s that Zelinsky, a past president of the AAG, brought light to the issue. Since then, pressure has been placed on the AAG to take affirmative action in incorporating minorities into academic geography and Zelinsky's study has served as platform for the production of further studies. In the past 43 years, geography as an academic discipline has studied the progress of women's place and time and as producers of original research and active contributors to the body of knowledge. However, the sub-discipline of physical geography has not been extensively studied and the sub-fields that compose it even less. The purpose of this thesis was to provide a census of the current state of women representation in geography-based academic geomorphology. The results show that in the 41 years analyzed there has been a positive improvement. However, the improvement has been very slow and if it continues at the current rate it will take just over a couple of hundreds of years to reach gender equality in geography-based academic geomorphology. Despite the rather low point at which the subfield currently resides, we cannot, we cannot ignore the fact that we are in the 21st century and in recent years there has been a big push to get youth involved and interested in pursuing degrees in science, technology, engineering, and mathematics (STEM). President Barack Obama is especially one who has arduously focused on improving STEM education in the U.S. and who has "secured more than $1 billion of private investment for improving STEM education, and commitments from college and university leadership to help underrepresented students earn STEM degrees" (Ransom, 2016, p. 40). These are the

types of innovations happening now that give hope to minorities and young women and that serve as an example to broaden the acceptance of others by those who are more privileged. With that in mind, the future of geography-based female geomorphologist in academia and in other public and private sectors looks hopeful and inviting. It is in their best interest to bring equality to academic geography sooner than in 200 years.

APPENDIX SECTION

NPar Tests

Notes

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a. Based on availability of workspace memory.

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Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
1973	75	1.99	.115	1	2
1980	105	1.97	.167	1	2
1990	175	1.94	.233	1	2
2000	218	1.87	.340	1	2
2010	223	1.83	.381	1	2
2014	200	1.83	.377	1	2

Chi-Square Test

Frequencies

1973

	Observed N	Expected N	Residual
Female	1	37.5	-36.5
Male	74	37.5	36.5
Total	75		

1980

	Observed N	Expected N	Residual
Female	3	52.5	-49.5
Male	102	52.5	49.5
Total	105		

1990

	Observed N	Expected N	Residual
Female	10	87.5	-77.5
Male	165	87.5	77.5
Total	175		

2000

	Observed N	Expected N	Residual
Female	29	109.0	-80.0
Male	189	109.0	80.0
Total	218		

2010

	Observed N	Expected N	Residual
Female	39	111.5	-72.5
Male	184	111.5	72.5
Total	223		

2014

	Observed N	Expected N	Residual
Female	34	100.0	-66.0
Male	166	100.0	66.0
Total	200		

Test Statistics

	1973	1980	1990	2000	2010	2014
Chi-Square	71.053[a]	93.343[b]	137.286[c]	117.431[d]	94.283[e]	87.120[f]
df	1	1	1	1	1	1
Asymp. Sig.	.000	.000	.000	.000	.000	.000

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b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 52.5.

c. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 87.5.

d. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 109.0.

e. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 111.5.

f. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 100.0.

REFERENCES

Association of American Geographers. 1973. *Guide to Graduate Departments of Geography in the United States and Canada 1973–1974*. Washington, DC.

_____. 1980. *Guide to Graduate Departments of Geography in the United States and Canada 1980–1981*. Washington, DC.

_____. 1990. *Guide to Departments of Geography in the United States and Canada 1990–1991*. Washington, DC

_____. 2000. *Guide to Programs in Geography in the United States and Canada 2000–2001*. Washington, DC

_____. 2010. *Guide to Programs in Geography in the Americas 2010–2011*. Washington, DC

_____. 2014. *Guide to Programs in Geography in the Americas 2014–2015*. Washington, DC

Brinegar, S. J. 2001. Female Representation in the Discipline of Geography. Journal of Geography in Higher Education 25 (3), 311-320.

Domosh, M. 1991. Toward a Feminist Historiography of Geography. Transactions of the Institute of British Geographers 16, 95-104.

Dunbar, G.S. 2001. Geography: Discipline, Profession and Subject since 1870. An International Survey. Dordrecht, the Netherlands. Kluwer Academic Publishers.

Falconer Al-Hindi, K. 2000. Women in Geography in the 21st Century. Introductory Remarks: Structure, Agency, and Women Geographers in Academia at the End of the Long Twentieth Century. The Professional Geographer 52 (4), 697-702.

Golledge, R. G., Halperin, W. C. 1983. On the Status of Women in Geography. The Professional Geographer 35 (2), 214-218.

Kaplan, D. H., Mapes, J. E. 2015 in press. Where Are the Women? Accounting for Discrepancies in Female Doctorates in U.S. Geography. The Professional Geographer. DOI: 10.1080/00330124.2015.1102030

Lee, D. R. 1990. The Status of Women in Geography: Things Change, Things Remain the Same. Professional Geographer 42 (2), 202-211.

Luzzadder-Beach, S., Macfarlane, A. 2000. The Environment of Gender and Science: Status and Perspectives of Women and Men in Physical Geography. Professional Geographer 52 (3), 407-424.

Madge, C., Bee, A. 1999. Women, Science and Identity: Interviews with Female Physical Geographers. Area 31 (4), 335-348.

Monk, J., Droogleever Fortuijin, J., Raleigh, C. 2004. The Representation of Women in Academic Geography: Contexts, Climate and Curricula. Journal of Geography in Higher Education 28 (1), 83-90.

Monk, J. 2006. Changing Expectations and Institutions: American Women Geographers in the 1970s. The Geographical Review 96 (2), 259-277.

Ransom, C. 2016. President Barack Obama on How to Change the Future. Popular Science 288 (2), 40-43.

Rubin, B. 1979. "Women in Geography" Revisited: Present Status, New Options. The Professional Geographer 31 (2), 125-134.

Sack, D. 2004. Experiences and Viewpoints of Selected Women Geomorphologists from the Mid-20th Century. Physical Geography 25 (5), 438-452.

Sawyer, C. F., Butler, D. R., O'Rourke, T. 2014. An Historical Look at the Binghamton Geomorphology Symposium. Geomorphology 223, 1-9.

Schlemper, M. B., Monk, J. 2011. Discourses on "Diversity": Perspectives from Graduate Programs in Geography in the United States. Journal of Geography in Higher Education. 35 (1), 23-46.

Thornbush, M. J. 2016. Introduction to the Special Issue on Gender and Geoethics in the Geosciences. International Journal of Environmental Research and Public Health 13 (4), 1-8.

Winkler, J. A. 2000. Faculty Reappointment, Tenure, and Promotion: Barriers for Women. Professional Geographer 52 (4), 737-750.

Zelinsky, W. 1973a.The Strange Case of the Missing Female Geographer. The Professional Geographer 25 (2), 101-105

_____. 1973b. Women in Geography: A Brief Factual Account. The Professional Geographer 25 (2), 151-165.

Zelinsky, W., Monk, J., Hanson, S. 1982. Women and Geography: A Review and Prospectus. Progress in Human Geography, 6 (3), 317-366.