**Personal, Background, and Future Goals Statement**

Through a New England field, over a fence, down a forest path, and into the underbrush. A few steps more, and we were stumbling over raised roots into a shady glade full of large-leafed trees swaying in the breeze. We had found them: the runaway *Magnolia tripetala* trees from Alabama. The escapees, whose parents decorated a New England garden, were impossible to overlook. They seemed almost tropical, standing in stark contrast to the Massachusetts maples and oaks. Now to document them! As my team took cores and wrapped measuring tapes around their trunks, I couldn't help but think that this fieldwork was the most exciting way I had ever participated in research. The concepts of the biogeographical and climate change research had sparked my interest, but the excitement of finding these new arrivals made me certain I had found my calling: studying how the world around us is being shaped by climate change.

**Intellectual Merit and Research Experiences:** This fieldwork was one of my first research experiences - a multi-institution project funded by the Department of Defense to document the climate-driven northward range expansions of ornamental species in the United States. At each site in Massachusetts or Connecticut, Professor Jesse Bellemare, Dr. Gretel Clarke, and I noted details of the population and took voucher specimens. I also built a list of adventive plant species from a database, gathered information about adventive populations in the Northeast, and used GIS to map population distributions for fieldwork. **This project's novel use of the extensive historical plant data found in online herbaria helped me realize the power of large datasets for understanding species dynamics through time** and nurtured my curiosity about the possibilities for using large datasets to answer important ecological questions.

Inspired by my work the previous summer, I chose to complete **a senior thesis on the distribution and diversity of endemic forest plants in the eastern United States** with Dr. Bellemare. Over the course of the next summer and my senior year, I created maps showing the distribution of endemic herbs and shrubs to assess patterns of species richness, climate, and glacial history. I also compared ecological traits, including height and dispersal mode, between the small-ranged endemic species and a group of wider-ranging forest plant species. Endemic forest plants were rare or absent in areas once covered by ice but common to abundant in the southeastern US. I also found strong differences between unglaciated and formerly-glaciated regions in the relationship between environmental factors and endemic richness. In unglaciated areas, endemic plant richness was negatively correlated with mean annual temperature and positively correlated with elevational range. Compared to wider-ranging species, endemic herbs were less likely to produce diaspores dispersed by vertebrates. This work is now a manuscript in preparation (Bellemare et al. (including George), in preparation, *Ecological Monographs*).

Hence, my work showed how much both climate and history mattered: the distribution and diversity of endemic forest plants in the eastern United States today carry a persistent imprint of past climates and glacial history. Plant species vary widely in their dispersal ability, which affects how they respond or fail to respond to current warming. From this work, I learned about the power of large spatial datasets for revealing signals of ecological process, the ways in which diversity was shaped by climate history and ecological traits, and the power of studying past environmental change to gain insights both into current biodiversity and ecological responses to the climate changes of the Anthropocene.

For my PhD research, **I will work with large-scale paleoecological datasets to study climate-driven plant range dynamics.** Leveraging the extensive spatial distribution of fossil pollen cores uploaded to the Neotoma Paleoecology Database, I will investigate past vegetation responses to climate change and human disturbance in North and South America. Examining the

trends across time and space will also help the scientific community understand how ecosystems with different climates and ecological composition may respond to modern climate change.

Career Goals: Due to my passion for understanding the connections between ecology and geology, people and the environment, social justice and science, I am compelled to find a career path at the intersections of these fields. Once I complete my PhD, I would like to work in the government or at a nonprofit, integrating my science background with advocacy to push for substantive social and political action on climate change. Later on, I would be interested in returning to academia to teach at **the intersection of science and communication,** equipping students with the skills to interpret primary literature and think critically about climate change narratives presented to the public. My drive for studying and communicating climate change research has been a part of my life since long before I wandered into the magnolia grove expecting only maples, but it is only now in college and graduate school that I am finally getting a chance to put them into practice through research.

**Broader Impacts:** Before I began my Masters in Geography at the University of Wisconsin-Madison, I lived in Los Angeles for a year and worked as a door-to-door canvasser for Greenpeace. I walked all across the city from November to March with others who cared just as much about the environment as I did. By the end, my knuckles were sore from knocking and the soles of my shoes were worn. I'd talked about climate change and environmental issues with hundreds of people, rich and poor, black and white, young and old, liberal and conservative, from neighborhoods across LA.

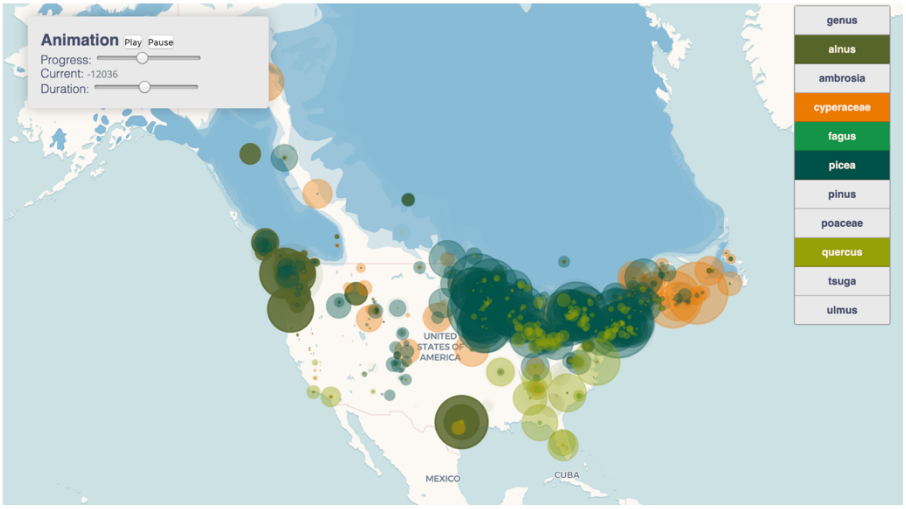
**Communicating with different people about the environment has been a passion since I was young**, explaining to my godmother why using efficient lightbulbs was important and tending to a native garden in a courtyard at my middle school during recess. At Smith College, my professors made learning how to communicate scientific ideas a priority. In class, I wrote essays on primary literature, prepared a lecture on biogeography, and prepared pamphlets on biofuel. In a practicum experience for the Climate Change Concentration, I managed the social media of Massachusetts Divest Now, the MA pension fund divestment campaign. I posted articles about climate change, the fossil fuel industry, and divestment.

Within a month of arriving at college, I joined a group of student environmental activists, Divest Smith College, and jumped into organizing events, writing articles in the school newspaper, and discussing the issue of fossil fuel divestment with students, faculty, college trustees, and alumnae. I co-led a committee devoted to faculty and alumnae outreach and then directed the campaign as a lead strategist for my last two years on campus. As a result of our work, the administration reinstated the Committee on Investor Responsibility, invested 16 percent of the endowment in Environmental, Social and Governance funds, and divested from fossil-fuel investment funds. In addition, I worked at the MacLeish Field Station, a building certified by the Living Building Challenge to some of the highest sustainable architecture standards. I led tours for elementary through college students and, in a week-long course during my sophomore-year winter break, developed a conservation and sustainability curriculum for elementary school students. **These experiences have helped me learn how to communicate research about climate change and ecology with people with different backgrounds.** The NSF GRFP would allow me to combine my passion for studying climate change with my love of science communication and education.

After working for Greenpeace, I began my graduate studies last fall in the Department of Geography at the University of Wisconsin, Madison. Geography has been the perfect home for me, allowing me to work at the intersection of climate science, biogeography, and science

communication through cutting-edge geovisualization. **I have continued to study climate-driven plant range dynamics through large-scale paleoecological datasets and delved deeper into the visualization of ecological data for both scientific and general public audiences.** Data visualization improves the accessibility of scientific data by showcasing spatial and temporal patterns and making visible the connections between, for example, climate and species' ranges.

My own work in geovisualization has spanned several different mediums. I developed a figure for the 2022 IPCC WG1 report showing plant community turnover in North America and Europe since the Last Glacial Maximum. In addition, **I developed animations of Neotoma Paleoecology Database pollen data showing climate-driven range dynamics over time** (see figure on right from award-winning poster) and an R script that allows researchers to create their own animations with taxa of their choice (George et al., in prep, *Open Quaternary*). My larger geovisualization project is the development of Ice Age Mapper (IAM), a customized interactive mapping interface that can be used for both research and education. Right now, IAM only visualizes pollen data from North America, in part because there is not a consistent taxa list for regions such as South America. After one is developed through my research project, I will add Latin American taxa to IAM, making it useful for geoscience education in across the Western Hemisphere. To share this work more broadly, **I will attend the next Latin American Congress**, a biogeography conference primarily focused on work in Latin America and **lead a workshop** on Neotoma on how to download data, analyze them, and visualize in IAM. At IBS-Ecuador 2019, the 2nd Latin American Congress, I co-organized a successful Neotoma workshop with Dr. Suzette Flantua.




I also plan to reach new audiences closer to home, here in Wisconsin. I will create an educational kit about pollen, past vegetation, and past climates that will include large 3-D printed pollen grains, a core of epoxied lake mud, and flipbook animations of range shifts of spruce and other taxa since the LGM. Then, **I will work to implement it within the Master Naturalist program, which is run by UW-Madison Extension and promotes understanding and stewardship of the natural environment through training volunteers in the science and conservation of Wisconsin landscapes.** Many volunteers are retirement-age adults with a keen interest in the outdoors, a unique and underappreciated audience for biogeography and climate-change outreach. I will attend a Master Naturalist Instructor Training and build a relationship between the Williams Paleoecology Lab and the Master Naturalist Program. In addition, the kit can be used at events like those I have volunteered at through the UW-Madison Graduate Women in Science chapter, such as the Wisconsin Science Festival, an event showcasing hands-on science for children. The GRFP would allow me to broaden my outreach and research in a way that my childhood self could only have dreamed.