

**Proposal Title:** SCC-CIVIC-PG Track B: A tourism decision support system for Western gateway and natural amenity region communities

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## Project Description

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Gateway and natural amenity regions (GNAR) throughout the Western U.S. are facing a number of unprecedented challenges that threaten their economies, the wellbeing of their residents, and the health of tourists who flock to these areas for recreation and rejuvenation. Extreme heat events in the summer months have driven outdoor recreationists and tourists indoors (1, 2). Smoke plumes from an increasing number of wildfires are affecting human health as well as regional economic activity (3). And most recently, the COVID-19 pandemic has led to virulent concerns amongst gateway community leaders about tourists spreading the virus, harming local residents, and overwhelming these communities' limited healthcare resources. With local economies that depend on the flow of outdoor recreationists and tourists, the disruption of those flows can have immediate and disastrous consequences for communities in GNARs (4). Our research team brings together expertise from the social and spatial sciences capable of transforming the way GNAR communities across the Western U.S. plan for and respond to interruptions in the flow of tourists brought about by natural disasters and crisis events like the COVID-19 pandemic. Through funding provided by the NSF Civic Innovation Challenge Planning Grant, **our vision is to develop predictive models of tourism flows and a respective decision support system that GNAR communities can use to explore and inform local policy decisions.**

We will execute on this vision by leveraging an established research team with demonstrated experience integrating disparate datasets to quantify the volume and spatial distribution of tourism flows across large geographic scales. The data and models used by our research team are ready to be piloted with willing GNAR communities through this Planning Grant. If funded, the lessons learned from the pilot will be incorporated into our Full Award proposal to scale-up the implementation across all GNAR communities in the Western U.S.

Our research-to-innovation pipeline will be facilitated through the GNAR Initiative ([www.gnar.usu.edu](http://www.gnar.usu.edu)), an affiliation of university faculty, government and state agencies, non-profit organizations, and community leaders committed to preparing for and responding to planning, development, natural resource management, and public policy challenges. The Initiative provides a forum where GNAR community leaders across the Western U.S. can meet, share ideas, and identify immediate and high priority needs that would allow them to make more informed decisions as they respond to natural disasters and crisis events. By working through the Initiative, we will be able to generate impacts on a short timescale and have the capacity to engender long-lasting impacts on the way GNAR communities across the Western U.S. plan for and respond to interruptions in the flow of tourists brought about by natural disasters and crisis events.

## Vision for Research-Centered Pilot Project

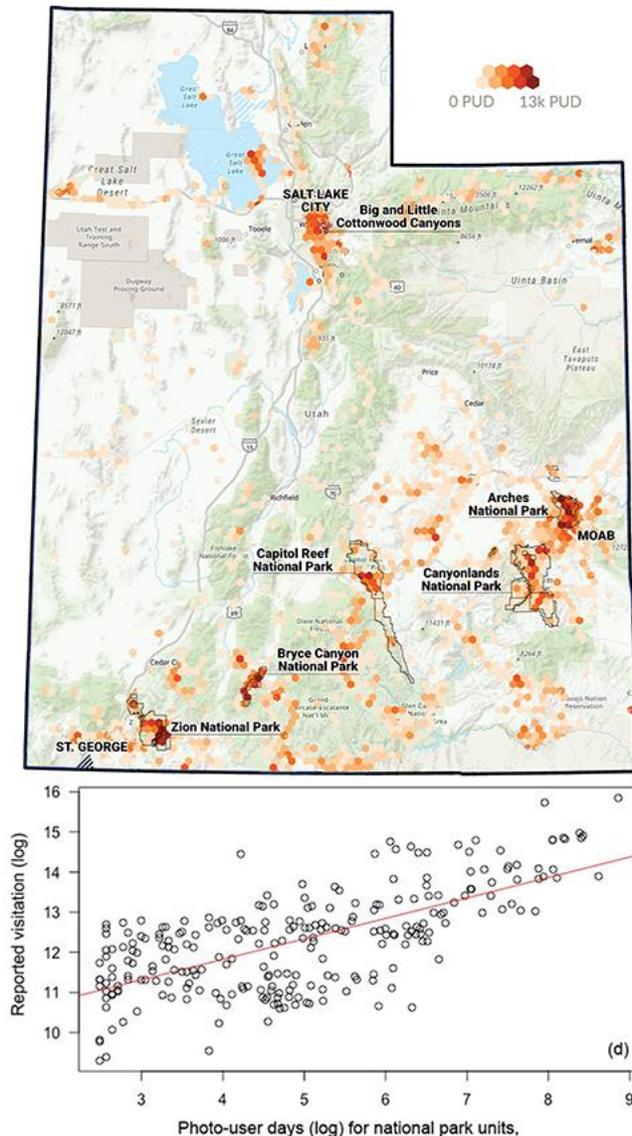
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### Project Vision and Goals

**Vision:** Develop predictive models of tourism flows and a decision support system that GNAR communities can use to explore and inform local policy decisions

The proliferation of publicly-available mobility data has provided researchers and analysts with the ability to quantify the volume and spatial distribution of tourism flows across large geographic scales (5, 6). Monitoring the passive positioning of phones on mobile networks allows researchers to track individuals' spatial behavior for long periods of time at high spatial resolutions (7). Additionally, the ubiquitous use of social media applications has provided researchers with the ability to access spatially-explicit information on the outdoor recreation and tourism experiences individuals share their social networks (5, 6).

Recent research by our team has shown publicly-available mobility data can provide a valid representation of visitation to parks, protected areas, and public lands (Figure 1; 8). We have also shown that publicly-available mobility data can be paired with weather and climate data to understand how extreme temperatures influence the decisions of where tourists choose to participate in outdoor recreation (Figure 2; 9). To date however, analyses of publicly available mobility data has been a slow process driven by the interest of researchers and analysts equipped with the technical skills required to acquire and analyze such data. Through this project, we will be integrating publicly available mobility data into an interactive tourism planning and management tool, rapidly accelerating the ability of these data to be used by GNAR communities in their efforts to plan for and manage tourism during natural disasters and crisis events.



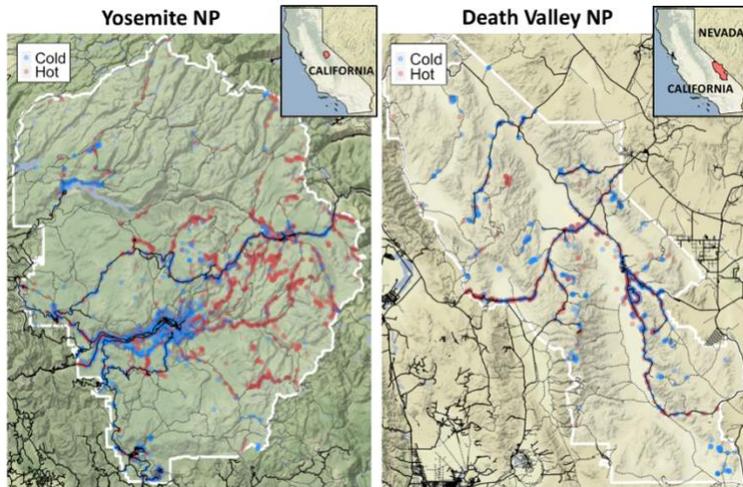
**Fig. 1.** Our recent research shows that publicly available mobility data can provide a valid representation of visitation to parks, protected areas, public lands (8).

### Team Members and their Roles

Our interdisciplinary and interinstitutional research and engagement team has experience working together on research projects utilizing publicly available mobility data to quantify the volume and spatial distribution of visitation to GNARs. We also have experience building forums where representatives of GNAR communities meet, share ideas, and identify immediate and high priority needs that allow them to make more informed decisions as they respond to natural disasters and crises events.

**Jordan W. Smith, Ph.D.** has worked extensively with publicly available mobility data to quantify the volume and spatial distribution of visitation to GNARs (5, 8–10). He leads the Institute of Outdoor Recreation and Tourism, an Extension program dedicated to working with GNAR communities and outdoor recreation planners and managers to provide data and information on how to best manage outdoor recreation and tourism throughout the Intermountain West. With technical expertise in the publicly available mobility data and established connections with GNAR community leaders across the Intermountain West, Dr. Smith is well-positioned to bridge the technical and capacity building components of the project.

**Derek Van Berkel, Ph.D.** has considerable experience in using social media data to quantify the preferences of outdoor recreationists and tourists (10–12). Dr. Van Berkel will be leading the development of the project’s decision support system.



**Fig. 2.** Publicly available mobility data can be paired with weather and climate data to understand how extreme temperatures influence the decisions of where tourists choose to participate in outdoor recreation (9).

**Senior Personnel: Danya Rumore, Ph.D.** focuses on: (1) identifying the emerging challenges faced by GNARs; and (2) working directly with communities in these regions to collaboratively develop sustainable policy and planning solutions. Dr. Rumore will be facilitating regular planning meetings and workshops with GNAR communities in our pilot project to ensure our team is able to: (1) identify the civic priorities of these communities; and (2) ensure that they are being addressed by the work of the research team. **Jake Powell** is the GNAR Initiative Lead and as such will work to integrate the activities of our pilot project into the broader outreach and education tools provided by the

GNAR Initiative. Currently, the GNAR Initiative hosts *listening sessions*, *research Q&A's*, and *Community Q&A's* with GNAR community leaders across the West on a regular basis ([www.usu.edu/gnar/gnar\\_network](http://www.usu.edu/gnar/gnar_network)). **Natalie Randall** is the Director of Economic Development & Visitor Services within San Juan County, Utah, the home of our pilot project. As the project's civic partner, Ms. Randall will be working with the research team to develop, pilot, and evaluate the project to ensure that it is responsive to the civic priorities of communities within San Juan County.

### Tasks to be Performed During the Execution of the Planning Grant

The activities supported through this planning grant are organized into three phases: (1) Identification of civic needs and applicable scientific capacities; (2) Data curation and decision support system development; and (3) Tool evaluation and refinement.

**Identification of Civic Needs and Applicable Scientific Capacities.** The project team will host an initial project kick-off workshop with stakeholders in GNAR communities throughout San Juan County willing to provide input into the development of predictive models of tourism flows and a respective decision support system that GNAR communities can use to explore and inform local policy decisions. The specific focus of this initial workshop will be to: (1) identify the key tourism metrics that civic partners use to make planning and policy decisions (e.g., visitation to parks and protected areas, transient room tax, hotel occupancy rates, etc.); and (2) identify the ways that geophysical processes (e.g., extreme heat events, wildfires, etc.) and crisis events (e.g., global pandemics) influence those key metrics. These discussions will serve as a scoping process providing the research team with the opportunity to understand how business owners, local elected officials, land managers, and tribal leaders make adaptive planning decisions in response to disruptions in the local travel and tourism industry. The project team will reconvene workshop participants monthly throughout the duration of the planning grant to: (1) discuss the availability of data that can inform local decision-making processes; and (2) identify critical and desired functionalities of a decision support system.

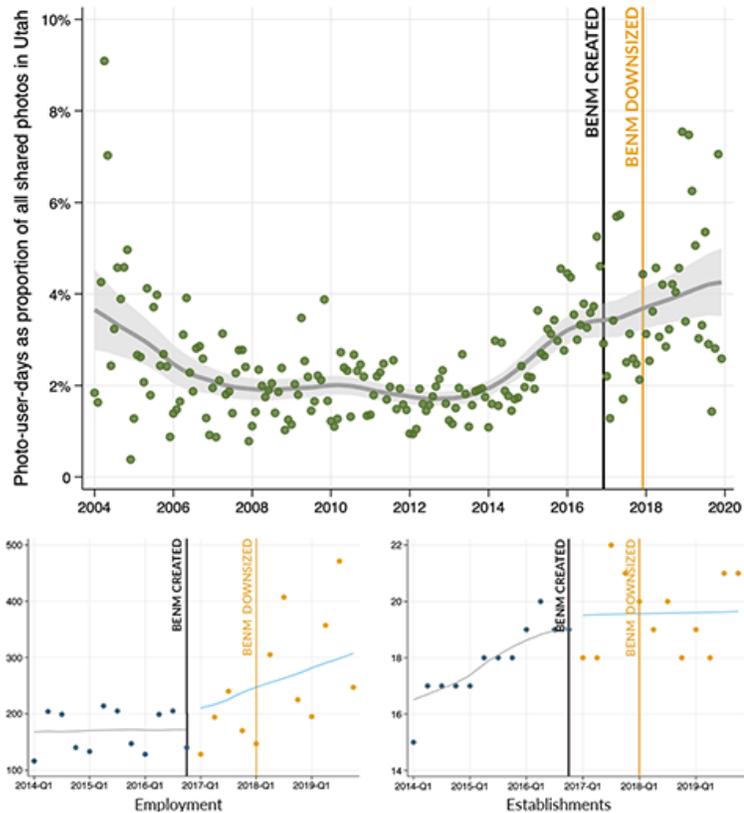
**Data Curation and Decision Support System Development.** After the initial project kick-off workshop, the research team will begin curating relevant data identified by the project’s civic partners. Our research team has worked in San Juan County before, curating social media, weather, climate, and economic indicator data across the region

(Figure 3; 13). This experience will hasten the data curation process for the pilot project. The work funded by this planning grant is expected to generate a prototype decision support system with functionalities limited to visualizing the data integrated into the tool and viewing historical relationships between key tourism metrics and historic climate data and data on crisis events that may influence those key metrics (e.g., regional wildfires, statewide travel restrictions, etc.). If funded, the scope of our Full Award proposal would involve increasing: (1) the geographic scope of data integrated into the tool; (2) improving the tools interactive capabilities (e.g., by allowing users to explore how key tourism metrics would likely respond to an increased occurrence of extreme heat events or the prolonged periods of travel restrictions); and (3) integrating predictive models into the tool. These predictive models will integrate disparate types of data (e.g., weather, climate, local and state policy, social media, mobile location data, etc.) to estimate visitation flows in and around GNAR communities.

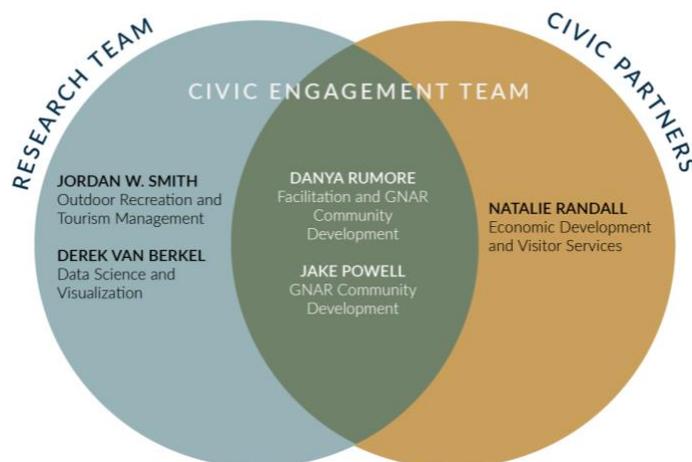
**Tool Evaluation and Refinement.** The planning grant will conclude with an evaluation workshop where stakeholders will critically review the utility of the decision support system to inform their planning efforts and the development of local tourism and economic development policies. The results of the evaluation workshop will be used to inform the goals and project activities of our Full Award grant application.

**Respective Roles of Each Organization**

Our project team is comprised of individuals with expertise in both



*Fig. 3.* The decision support system will allow users to explore how visitation changed before and after specific hazards and crisis events. In this example, we show data from our pilot area of San Juan County, Utah and how a user might explore how visitation to the county and other economic indicators changed before and after the designation of Bears Ears National Monument (13).



*Fig. 4.* The interdisciplinary and interinstitutional project team is comprised of individuals with expertise in both research and civic engagement.

research and civic engagement (Figure 4). The research team brings a wealth of experience in using spatial and social science research methods to explore visitation trends in and around GNAR communities (1, 5, 8, 9, 14–16). The community engagement team brings experience working with GNAR communities to collaboratively develop planning and policy solutions to emerging development challenges (17–19). PI Smith and Co-PI van Berkel will lead the project’s research efforts while Senior Personnel Rumore and Senior Personnel Powell will lead the project’s civic engagement efforts.

**Research Questions.** The activities outlined above will allow us to make contributions to the understanding of how new technologies can best be used to improve the adaptive capacities and resilience of GNAR communities. These contributions will come by focusing our efforts on two research questions:

- (1) What is the structure and essential functions of a web-based decision support system for monitoring visitation dynamics in GNAR communities?
- (2) What methods work best for co-producing knowledge about how GNAR communities can proactively prepare for natural hazards and crisis events?

We hypothesize that by using regular project workshops (in a format similar to the *listening sessions* we currently organize with community leaders in GNARs) to identify the needs of local stakeholders, we will increase the ability of our decision support system to inform local planning efforts and the development of local tourism and economic development policies. We also hypothesize that our civic engagement efforts will: (a) reveal new knowledge about natural hazards and crisis events that will bolster resilience indicator definition for GNAR communities; and (b) enhance our understanding of the visual functional requirements of decision support systems used in multi-stakeholder contexts.

### **Intellectual Merit**

By utilizing an inclusive engagement approach, this project will bring new insights into the efficacy of co-producing decision support systems. It will also advance our understanding of effective data visualization using free and open source web mapping approaches; and provide new knowledge on resilience indicators for GNARs throughout the Western U.S. Overall, these insights can be used to improve approaches to civic engagement in the context of complex feedbacks from natural hazards and other crisis events on local economies. The project’s contributions to knowledge are unique for each research question:

*What is the structure and essential functions of a web-based decision support system for monitoring visitation dynamics in GNAR communities?* The appeal of decision support systems is that they promise to allow scientists to address complex environmental and social problems in a way that meets the needs of policy makers. However, decision support systems are often developed on a case-by-case basis, have fragmented development strategies that frequently use disparate programming languages, and under report set up time and effort. Consequently, most decision support systems end up being experimental, small-scale and underused by practitioners (20). Recent developments in the construction of decision support systems has been focused on lowering the technical hurdles for deployment in a web-based context by utilizing free and open source software (21). The goal of these recent developments has been to hasten the development of prototype decision support systems through the construction of a user interface and core functions that allow stakeholders to explore and evaluate the system early on in the development process. Rapid prototyping is likely to increase the use and effectiveness of a decision support system (22). The decision support system we build throughout the duration of the planning grant will utilize free and open source software, particularly the R Shiny package (23) and the virtualization software Docker (24, 25).

*What methods work best for co-producing knowledge about how diverse stakeholders can proactively prepare for natural hazards and crisis events?* Decision support systems are often built for a single type of stakeholder and, as such, have limited ability to lead to the co-production of knowledge informed by the perspectives of multiple types of decision makers (26). The resilience of GNAR communities depends on coordinated decision making across multiple groups (17). To this end, we will be implementing an iterative research and design process that acknowledges, defines, and differentiates the requirements of the decision support system across users (26). The approach involves scientists, technological specialists, and stakeholders collaborating to collectively define the structure and functionality of the decision support system. Our workshops will be held with stakeholders from: (1) land management agencies; (2) municipal and county governments; (3) local businesses; and (4) tribal leaders. These groups will be asked to identify information they find useful and information they find useable when making local tourism and economic development policies (27). These discussions will require detailing the planning and management activities undertaken by each group; it will also involve discussion about the decision making goals and vision for how each group can benefit from a more detailed understanding of key tourism metrics and how those are influenced by natural disasters and crisis events. These discussions will be held in a collaborative forum so that each group understands the needs, goals, and desires of other groups in the local tourism system. This user-driven process will ensure that all the project's decision support system is collaboratively developed, meeting the needs of all stakeholder groups (26).

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### **Civic Engagement**

The pilot project will focus on San Juan County, Utah. The county is home to Canyonlands National Park, Glen Canyon National Recreation Area, four national monuments, the Navajo Reservation, and over a dozen small communities which are heavily reliant on tourism to the region. The county's iconic southwestern landscape is full of deep canyons, flat-top mesas, high desert mountains, and thousands of red rock formations. The landscape also holds cultural significance for many native tribes (28) and extensive paleontological resources (29). The iterative planning process described above will be guided by trained facilitators, placing representatives from each stakeholder group on equal footing as the project's scientists and technical specialists. Our engagement process will be informed by approaches from decision support research that co-produces knowledge so that technological tools, such as our decision support system, can advance understanding of complex spatiotemporal processes.

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### **Broader Impacts**

Due to the transient nature of their residents and employees and the fact these places "host the world," GNAR communities are hit particularly hard by natural disasters and crisis events. Our research team has developed the GNAR Initiative. A primary goal of the GNAR Initiative is to build the capacity of communities to prepare for, and respond to, natural disasters and crisis events. We have hosted virtual *listening sessions* where representatives of gateway communities can meet, share ideas, and identify immediate and high-priority needs that would allow them to make more informed decisions. One common need repeatedly identified by GNAR community leaders during our recent *listening sessions* has been accurate data on how the flow of visitation and tourism have been disrupted by local and statewide travel restrictions and the closure of nearby national and state parks. By leveraging the current capacity of the GNAR Initiative to reach hundreds of communities across the Western U.S., we are confident that we can take the activities funded as part of this Planning Grant and develop a generalizable decision support system capable of transforming the way GNAR communities across the Western U.S. plan for and respond to interruptions in the flow of tourists brought about by natural disasters and crisis events.

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### **Results from Prior NSF Support**

PI Smith, Rumore, & Powell. \$1,000. *CONVERGE COVID-19 Working Groups for Public Health and Social Sciences Research* via the National Science Foundation funded CONVERGE: Coordinated Social Science, Engineering, and Interdisciplinary Extreme Events Reconnaissance Research award (#1841338).

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