Changing Tourist Movement and Social Media Behavior in a Destination: Visualizing COVID-19 Impacts through Flickr VGI

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ABSTRACT

Using Volunteered Geographic Information (VGI) from the social media site Flickr, this research explored the impact of COVID-19 travel restrictions on travel into and within Maine, a long-standing tourism destination with entrenched tourist consumer-behavior patterns. Publicly available geotagged Flickr photo posts and user counts were compared before and after March 2020, when COVID-19 travel restrictions began to be implemented. Density map visualizations of Flickr photo posts show not only how tourist numbers decreased but shifted from popular, coastal regions to more inland, rural, natural areas within Maine. More specifically, they indicate divergent movement patterns of visitors coming from places with and without travel restrictions, suggesting unintended effects of travel restriction policies. Differing levels of change between Flickr photo and user counts were also noted, suggesting a change in social media usage by various visitors, perhaps due to the heavy social and financial repercussions of restricted travel during a time of public health uncertainty. Understanding rapidly changing consumer behavior in a destination is valuable for tourism management at any time or place, but especially during a crisis with significant personal health consequences. VGI from social media, such as Flickr, can uniquely contribute to this understanding.

Keywords:
Destination Management, Volunteered Geographic Information, Social Media, Consumer Behavior, COVID-19, Maine

INTRODUCTION

When a destination faces a crisis, such as the severe decrease in visitors seen during the COVID-19 pandemic in 2020, visualizing rapidly changing travel patterns in as much detail as possible is valuable for understanding unintended consequences of policy, developing mitigation strategies, and taking advantage

of opportunities, in order to increase resilience and support revitalization efforts (Wang & Ye, 2017). Without cumbersome, time consuming, and expensive methods such as survey, questionnaires, or access to sales and high-cost cell phone data, it is hard for many tourism managers and businesses, especially those in rural or emerging destinations, to immediately extrapolate who exactly is traveling to the destination and what they are doing once there (Hadwen & Arthington, 2007; Torniai et al., 2007, Wood et al., 2013). Additionally, if travel restrictions or other mitigation policies are in place for health and safety reasons, it is vital to know if they are having the intended outcomes. Data that can be easily accessed in real time without human contact, such as from social media, can help with this work (Wang & Ye, 2017; Wood et al., 2013).

Tourism researchers are increasingly incorporating publicly available Volunteered Geographic Information (VGI) into their analysis (Hadwen & Arthington, 2007; Torniai et al., 2007) as it produces large amounts of data that can detail human activity in new ways. VGI from the photo sharing site Flickr in particular, has been building a base of literature due to its usefulness to tourism managers in representing tourist movement patterns and consumer social behavior (Beeco & Brown, 2013; Beeco et al., 2013; Riungu et al., 2019, Runge et al., 2020). When Flickr photo activity is used as a proxy for tourist activity, it forms a connection to space and place, which informs broader social theories of geography and tourism. This connection makes Flickr VGI useful and appropriate for this research.

The research question undertaken was if and how the COVID-19 pandemic changed travel patterns and tourist behavior within a destination? Specifically, the impact of COVID-19 travel restrictions on the behavior of differing groups of visitors into and within Maine, USA, was analyzed by comparing and visualizing VGI from the social media photo-sharing site Flickr. Flickr photo and user counts in Maine were assessed before and after March 2020, when various COVID-19 travel restrictions began, in order to gain insight and understand impacts on tourist consumer behavior and Maine communities.

LITERATURE REVIEW

Social Theory, Geography of Tourism, and VGI
Social theory as it relates to geography focuses on the relationships between space and society and is part of the foundation of human geography (Warf, 2015). Since geographic social theories have long prescribed human value and meaning to spatial patterns (Tuan, 1977) it is a lens that much research in tourism has taken, as travel is an inherently social activity that takes place in distinct spaces (Urry, 1990). Through time, this theoretical perspective has become important to the management of both urban and natural destinations due to the recognition that tourism can create and shape the value and meaning of a place for locals and visitors (Larsen, 2006; Urry, 1990). The geography of tourism discipline grew from this work and evolved to answer social science questions on how human behavior is affected by and affects the landscape on which tourism takes place (Williams & Lew, 2014).

For the past decade, social computing data has become an increasingly useful source of information about human behavior (Yan et al., 2020). One subset of this, geo-locational metadata, is part of a larger category of Volunteered Geographic Information. VGI describes the "engagement of large numbers of private citizens, often with little in the way of formal qualifications, in the creation of geographic information" (Goodchild, 2007, p. 212). In 2007, Goodchild stated that this novel phenomenon was driven in part by open resources such as Wikimapia and OpenStreetMap which invited interested users to help develop content not otherwise available online, representing "a dramatic innovation that will certainly have profound impacts on geographic information systems" (p. 212). At that time, he observed commercial services, such as Flickr, allowing users to tag uploaded photographs with latitude and longitude locations and noted the potential utility of this data to explore spatial patterns of social activity.

Goodchild's original analysis seems prescient as the amount of available VGI has exponentially increased. The variety of questions to which VGI has been applied and the ingenuity of research methods has likewise expanded at a rapid pace (Bugs et al., 2010; Ding & Hongchao, 2019; Elwood et al., 2013; Flanagin & Metzger, 2008; Li et al., 2018; Liu et al., 2018). In a recent review paper, Yan et al. (2020) report that a selection of 26 peer-reviewed international geospatial journals yielded 346 VGI-related papers since the term was first introduced. They note several social media sites that have become valuable sources of VGI, in particular, Twitter and Flickr both provide data-rich location-based images and text. Owuor & Hochmair (2020) also discuss the relative merits of social media sites most commonly used in VGI research: Twitter, Facebook, Flickr, Foursquare, YouTube, LinkedIn, and Yelp. As VGI offers detailed views and perspectives on an array of research on human interaction through real time occurrences and encounters with each other and the environment, this has benefited tourism management. Geo-visualizations of photos taken by tourists have been applied in urban settings with numerous studies using geo-tagged photos to understand tourist movement in urban destinations (Kádár , 2014; Kádár r & Gede, 2013; García -Palomares et al., 2015; Straumann et al., 2014). It has allowed tourism planners, policy makers, and businesses to visualize various experiences in a place to better understand the destination, how it is used, and by whom.

This integration of geo-visualizations (mapping) of spatial-related social science data has also advanced natural resources management, parks and public areas, and the outdoor recreation fields (Beeco & Brown, 2013; Beeco et al., 2013; Riungu et al., 2019). The expansion of online image-sharing sites (Torniai et al., 2007) has correlated to the expansion and growth of tourism globally (Brondoni, 2016), until the COVID-19 pandemic. With tourism's expansion, there was an increase in environmental impacts, especially in nature-based destinations (Hale, 2018). Before the pandemic, detailed information from VGI on where tourists were on the landscape was noted to be important for the mitigation of adverse impacts to natural attractions (Hadwen et al., 2007). VGI will continue to be useful to managing tourists and their impact in places like this after the pandemic has ended. The research in this paper applies this past workto tourist movement during the COVID-19 pandemic, viewing it as a human social activity with impacts and opportunities for the landscape, communities, and people in the destination. It contributes to the tourism geography discipline by analyzing the role of VGI datasets, such as from social media, in understanding tourist behavior in a rural destination during a unique time, the public health crisis brought on by COVID-19.

Tourist Photographs and Flickr

For many years in the tourism literature, social theories have recognized photographs as providing distinct evidence of the tourist experience (Chalfen, 1979). The activity of taking and sharing a photograph is considered social behavior. Photographs do not just verify a person's presence at a certain place and time, creating a record of their visit, but also make a statement of value that potentially influences other people and the place itself (Garrod, 2009; Hillman, 2007; Jenkins, 2003; Kádár, 2014; Larsen, 2006; Urry, 1990). Publicly posted photographs on social media are considered a form of modern communication. When the accompanying VGI is available, these photos can inform on tourist consumer behavior at a detailed level beyond the image itself (Girardin et al., 2008). It can give meaning to the act of posting the photo. Research using social media VGI during a time of crisis furthers the understanding of tourist social behavior through the photographs they take.

Flickr was chosen as the VGI data source in this research in part because of the importance of photography in travel. "Flickr is the largest active global community of photographers in the world...Together with SmugMug, which acquired Flickr [in 2018], the united brands have created the largest and most influential photography-focused community in the world" (Business Wire, 2018). While traffic on the Flickr platform has shrunk recently compared to other social media platforms, such as Facebook and Instagram, in 2018

Flickr still had more than 75 million registered photographers and there was an increase in unique visitors from 10.8 million in 2017 to 13.1 million (Guyann, 2018). As of February 2021, there were more than 7 billion monthly Flickr API requests (Smith, 2021) and over 100 million unique users continue to post tens of billions of photos to Flickr annually (Flickr.com, n.d.). The utility of Flickr remains strong and its longevity (it has been in existence since 2004) gives its datasets a temporal depth that younger social media sites do not have. The relative straightforwardness of obtaining locational data from Flickr also makes it particularly popular among researchers (Owuor & Hochmair, 2020). Flickr has a comparatively generous API rate limitation of 3600 queries per hour. Its continued use in tourism studies (Yan et al., 2020) is also supported by it being free to access, unlike many other social media platforms (Facebook, Instagram), in which the VGI is simply not accessible to the public or has a significant cost to access.

Tourism research papers on a variety of topics have used Flickr VGI as the primary data source for well over a decade and shown its usefulness in indicating meaningful travel behaviors (Runge et al., 2020). Several studies indicate accuracy in the levels of visitation estimated by photo data when compared to traditional sources such as survey and travel logs. Flickr photos have been taken to represent user days in a place, following the same patterns determined by survey data (Allan et al., 2015; Heikinheimo et al., 2017; Levin et al., 2015; Spalding et al., 2017; Wood et al., 2013). Flickr has also been used for estimating tourist visits to cities, national parks, and other natural places. Photo densities have approximated travel origins (Wood et al. 2013), movement patterns, and visitor behavior at a destination. Specific examples include Straumann et al. (2014) who study the differences between photo-taking behavior of Swiss nationals and tourists in Zurich. Sun et al. (2015) identify the most popular sightseeing routes used by tourists in Munich. Heikinheimo et al. (2017) argue that the origin of users posting photos corresponds to information about visitor origins from other sources and provides a precise location of where tourists are on the landscape. Walden-Schriener et al. (2018) identify tourism activity hot-spots in protected mountain regions in Argentina and Australia. In Ding & Hongchao's (2019) discussion of Flickr photos in London, they indicate the accuracy of geolocation information on Flickr with 97% of most London landmark building images (tagged with the building name) located within 300 meters of the building, supporting the use of Flickr photos as a means to estimate overall visitor activity in a certain location. Chen et al. (2019) use Flickr to define Visitor Urban Areas of Interest. These are places where multiple Flickr users have gathered and taken numbers of photos. It reflects a consensual view that this aspect of the environment is of interest (Hu et al., 2015), of value, and attractive to visitors. Giglio et al. (2020) explore how Flickr tags reflect perceptions and influence people's interests in Italian tourist cities. Runge et al. (2020) identify a 600% increase in Arctic tourism over 10 years with Flickr. Flickr data also has provided spatial, temporal and semantic information on tourism patterns of visitors from different countries (Gao et al., 2017; Jiang et al., 2015; Lansley & Longley, 2016; Lloyd & Chesirer, 2017).

This research shows that Flickr is a widely used and generally accepted resource within tourism studies providing high-level human behavior information to tourism stakeholders (Andrienko & Andrienko, 2011; Girardin et al., 2008). VGI from social media photo sharing sites like Flickr, advance the study of human travel behavior in the modern world as it not only indicates places of value through the posting of photographs, but can allow more detailed tracking of various visitor origins, movements, and social media usage through time. This data is immediately accessible to the public and involves no human contact to access, a helpful trait during a public health crisis such as COVID-19. Past research indicates that Flickr activity (numbers of photos, number of visitors), of various groupings of people (locals, internationals, market segments), in different places (urban, rural, landmarks, countries), through time (2004 to 2021) provides meaningful tourism socio-behavioral patterns for tourism managers and businesses on which to base current research and advance social theories of tourism geography.

COVID-19 Pandemic

The COVID-19 pandemic provides an opportunity to study resilience and revitalization of the tourism and hospitality industry, as rapid changes in the spatial character of destinations and consumer behavior has been evident during this phenomenon. Travel throughout the world was affected by new policies and practices connected to the pandemic in various ways. While much tourism research done on destination usage in the past was through in-person methods such as visitor intercept survey, interviews, and observation, they have temporal limitations (Hadwen & Arthington, 2007), can be expensive and time consuming, and were many times not feasible during the COVID-19 pandemic in 2020 because of social distancing restrictions. Social media VGI from sites such as Flickr is uniquely positioned to provide data during these times as it is free, publicly accessible, and can be downloaded from a computer the moment it is posted (Wang & Ye, 2017). The research in this paper advances the tourism management discipline by applying geographic social theory and a tourism geography approach to new patterns of tourist behavior, in order to understand rapidly changing travel patterns into and within a destination during a public health crisis.

Travel Shaming

While there is no scholarly literature on "travel shaming", numerous articles in worldwide news outlets, magazines, and travel blogs began to discuss this phenomenon in 2020. Travel shaming is loosely defined as disparaging people for their travel during the COVID-19 pandemic, as that travel is perceived to be putting others at risk (Compton, 2020; Rogers, 2021; Snow, 2020). In the past, travel tended to be a badge of honor, not something to cause public shame (Compton, 2020), so this is a relatively new phenomenon. Snow et al. (2020) discussed how visitors in 2020, in some places, received "go back home" notes on cars due to their out-of-state license plates. There were similar incidences of tensions and confrontation between residents and those appearing to be visitors, reported in the newspapers in Maine during this time (Graham & Gray, 2020). Another travel story makes note that travel shaming is not necessarily deterring travel; it is just making travelers less apt to post about it on social media (Rogers, 2021). This fledgling concept is relevant to the current research as it could be a factor in potential changes in Maine visitor's social media behavior on Flickr seen during the time of COVID-19 travel restrictions in 2020.

Maine Tourism

The state of Maine, USA has been a tourism destination in the northeastern United States for over 200 years and is the focus of this research. It is within a day's driving distance of Quebec City, Boston, New York City, Philadelphia, and Washington DC. Maine has 1.3 million inhabitants and hosted over 37 million out of state visitors in 2019 (Maine Office of Tourism, 2020). Tourism contributes significantly to the Maine economy. In 2019, it brought in $6.5 billion in direct restaurant and lodging sales (Gabe & Crawley, 2020; Maine Office of Tourism, 2020).

The interior of Maine is a vast wooded landscape, which for many years supported a global paper and wood products industry, and more recently has seen a decline in manufacturing and loss of population. Its inland lakes and mountains are considered some of the most remote wilderness in the eastern United States hosting Mount Katahdin in Baxter State Park, which is the highest peak in Maine and the pinnacle of the Appalachian Trail, a multistate hiking trail. The unorganized territories around it have attracted the wonder of famous figures for hundreds of years, such as writer Henry David Thoreau. It is a region that has looked to increase tourism but without much success compared to Maine's coast. Most visitors to Maine travel only along Maine's more populated south coast to destinations like Kennebunkport, home of former Presidents' Bush Family compound, and Acadia National Park, one of the most popular coastal national parks in the United States. Along Maine's south coast are beaches and quaint towns where travelers can see lighthouses still in use and witness generational family lobstering and fishing activities. This region has more tourism infrastructure then the interior and brings in the majority of hospitality sales (Maine Office

of Tourism, 2020). Any change in travel patterns in a place like this is extremely impactful to the economy. Maine provides a strong historical context to study changing travel patterns into and within a rural destination during the pandemic.

Due to COVID-19, on March 3, 2020, Maine suspended all non-essential government travel. This eventually led to stay-at-home orders for Maine residents and many restaurants, lodging establishments, and other places of business to be shut down. By April 3, 2020 an executive order was in place mandating non-essential travelers arriving in Maine from anywhere except New Hampshire and Vermont (due to lower rates of COVID-19) to self-quarantine for 14 days, severely reducing leisure travel, Maine's largest market (Maine Office of Tourism, 2020). Some businesses reopened slowly and by June 8, 2020, the option of producing proof of a negative COVID-19 test for restricted visitors upon entering Maine was allowed. July 3, 2020 visitors from Connecticut, New York, and New Jersey joined New Hampshire, Vermont, and Maine in exemption from all COVID-19 travel restrictions. The Federal Government closed the border between Maine and Canada to non-essential travel on March 21, 2020 and it remained closed throughout the rest of the study period (State of Maine Office of the Governor COVID-19 Response website, n.d.). Maine Office of Tourism estimated an almost 30% decrease in visitors to Maine in 2020 (Gabe & Crawley, 2020). These restrictions set the basis to investigate changes in travel patterns in Maine in 2020.

METHODOLOGY

This research uses the data attached to publicly available user-generated geotagged Flickr photographs posted in Maine between March 1 and August 31 of 2013 to 2020. These dates were selected in order to establish a 7-year foundation of typical travel patterns before COVID-19 disrupted the industry in 2020. Numbers of photographs, location densities, and Flickr user origins were analyzed from 2013 to 2019 and compared to 2020 when COVID-19 travel restrictions were in place in Maine. The March-August timeframe was chosen as it correlated to the first set of major COVID-19 travel restrictions in 2020 (by September 2020 travel restrictions started to ease) and includes the summer tourist season, when the majority of visitors typically travel to Maine.

The metadata from Flickr photos was obtained from the Flickr Application Programming Interface (API) on September 19, 2020. The Flickr API allows users to interact with its database to pull or manage data. To interact with the API, Flickrapi software was downloaded from the open source Python Package Index (Stuvel 2018) and the metadata for photos was requested. The flickr.photos.search function allows the user to search for publicly shared photos. A geographical bounding box was chosen to encompass all of Maine. Photo attributes selected include accuracy, latitude, longitude, owner (Flickr user ID), date taken, title, and tags.

One well-established technique to identify where a Flickr user is from involves downloading the user's self-identified location from their profile (Girardin et al., 2008; Li et al., 2018; Liu et al., 2018). Once a user's location is determined, users can be separated into categories for further study. Flickr.people.getinfo returns information that an individual Flickr user has added to their public profile including user-identified location. Location information was requested for each user in the data set and was added to the metadata for each photo. Photos that did not have a user-identified location were dropped from the dataset. The data was further refined by removing any duplicate photos, defined as photos that have the same owner, latitude, and longitude. Finally, location codes were assigned based on Maine resident versus non-resident users. Non-residents were categorized by U.S. state, Canadian province, or other international categories. After all these processes were implemented, the final data set for Maine contained 6,863 photos and 921 users.

Density geo-visualizations were created from the dataset to distinguish places within the destination that had the highest amounts of Flickr photo activity. This activity was considered a proxy for tourist behavior

based on previous research. Pie charts and density maps were created to show any out-of-state photo location changes (or visitor movement changes) from March to August of 2013-2019 to March to August of 2020. Next, pie charts and density maps of visitors in 2020 coming from states with travel restrictions were compared to those coming from states without travel restrictions, to distinguish if there were differing patterns due to restriction status. Lastly, a comparison of the amount of Flickr users to the total number of photos posted was undertaken for 2020 to determine if there was changing social media usage of travelers from restricted states versus those coming from states with no travel restrictions. This was done to investigate ways social media such as Flickr might best be used in crisis situations where there are potential social stigmas attached to travel. The implications of these results are discussed.

RESULTS

When comparing the average annual amount of total Flickr photos posted in Maine from March-August 2013-2019 to March-August 2020, overall photo amounts of out-of-state visitors decreased by 17%. See Figure 1.

Figure 1:

Average Annual Geo-tagged Flickr Photos Posted in Maine Decreased in 2020
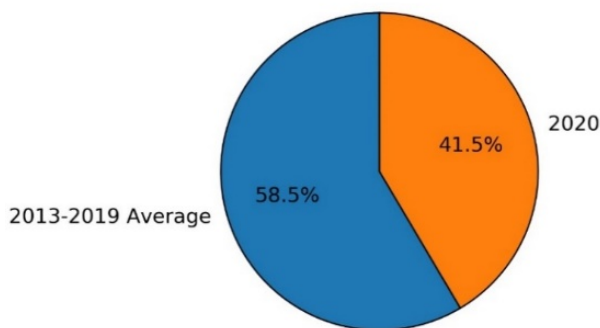
Geo-visualizations provide further details on where visitors are in Maine to see if there is an actual change in visitor movement or just a decrease. Figure 2 displays density maps of all Flickr photos posted in Maine from March-August 2013-2019 compared to March-August in 2020. There are clear differences in visitor movement. From 2013 to 2019, there is a single hotspot (places with the highest amounts of photo density) in Acadia National Park, one of the most popular National Parks in the USA and most of the Flickr activity is along Maine's south coast, which is the most urban and popular tourism region of Maine. In 2020 however, the pattern shifts and there are numerous new hotspots visible. One is still in Acadia National Park, but one also appears in the far south, near coastal towns and beaches in Maine, which are the closest drivable communities and natural attractions in Maine to most out-of-state visitors. Short drives (2 hours or less) dominated the US travel market in 2020 (Arrivalist, n.d.) and so out-of-state visitors seem to have consolidated at that point on the south coast. More striking, there is a shift into the rural, northern part of the state around Baxter State Park, which is located in a sparsely populated inland county in Maine, and has little tourism infrastructure.
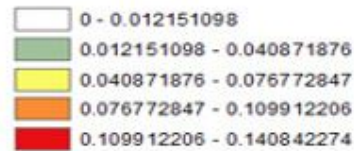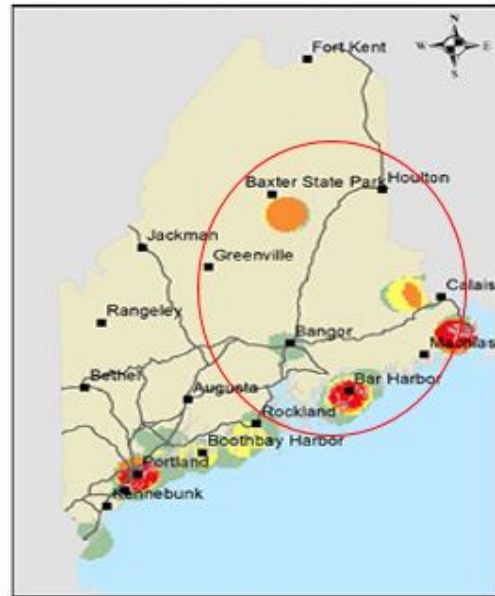
Figure 2.

Density Maps of Flickr Photos Posted in Maine from March to August 2013-2019 compared to 2020

Density map for all photos from 2013-2019.   Density map for all Photos from 2020.

0 - 0.126020886	0 - 0.012151098
0.126020886 - 0.552553115	0.012151098 - 0.040871876
0.552553115 - 1.192351459	0.040871876 - 0.076772847
1.19235146 - 1.880619374	0.076772847 - 0.109912206
1.880619375 - 2.471948147	0.109912206 - 0.140842274

Note: Hotspots (places with the highest amounts of photo density) are in orange and red. Red circle indicates a shift in travel to more northern, rural, inland regions.

Flickr photos were next categorized into those posted by travelers living in places that had COVID-19 travel restrictions to Maine from March-August of 2020 and those that did not. In Figure 3 the average annual photo posts in Maine from travelers with restrictions (all states except for Maine, New Hampshire, Vermont, Connecticut, New York and New Jersey) for 2013-2019 were compared to the proportion of 2020 photo posts from this same group and showed a decrease of 76%.

Figure 3:

Average Proportion of Annual Flickr Photo Posts in Maine from Visitors With COVID-19 Travel Restrictions Decreased in 2020
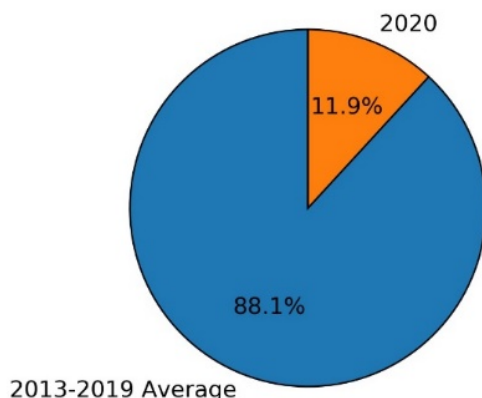

Figure 4 compares Flickr photo posts in Maine between 2013-2019 and 2020 from visitors that were exempt from Maine's COVID-19 travel restrictions for at least part of March-August of 2020 (New Hampshire, Vermont, Connecticut, New York and New Jersey). Among exempt visitors, there is an increase of 59% in the proportion of photo posts in 2020.

Figure 4:

Average Proportion of Annual Flickr Photo Posts in Maine from Visitors Exempt from COVID-19 Travel Restrictions Increased in 2020
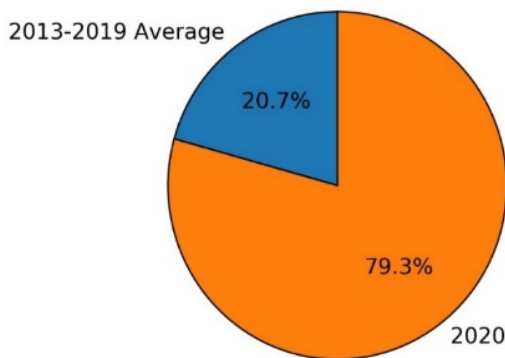
This research also took into consideration proportions of individual Flickr users in 2013-2019 and in 2020 and compared the changes in their numbers to those seen in photo counts during the same timeframes. When the average proportion of annual Flickr users in Maine originating from places that had COVID-19 travel restrictions to Maine was compared for 2013-2019 to 2020, the total decreased by 46%. See Figure 5. When the average number of annual Flickr users originating from places that were exempt from Maine's COVID-19 travel restrictions was compared for 2013-2019 to 2020, Figure 6 shows that there was an increase of 17%. This pattern of user decrease and increase is similar to results seen with photos.

Figure 5:

Average Proportion of Annual Flickr Users in Maine with COVID-19 Travel Restrictions Decreased in 2020
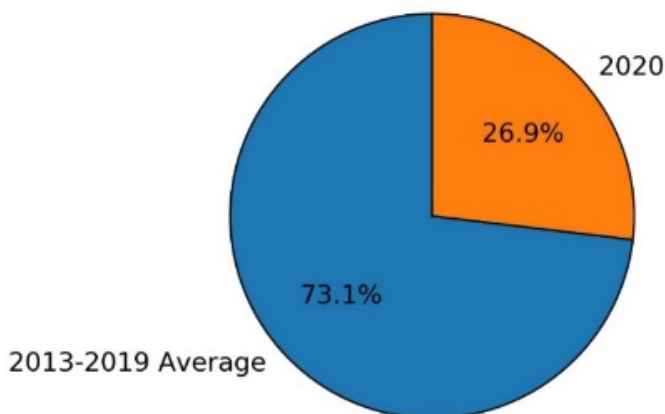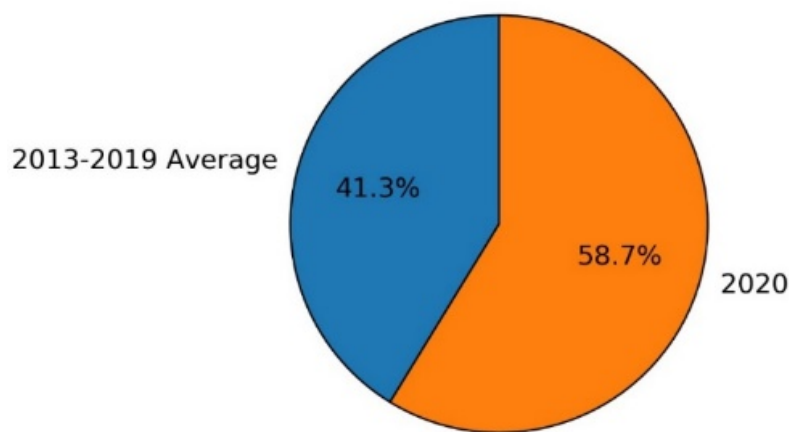

Figure 6:

Average Proportion of Annual Flickr Users in Maine Exempt from COVID-19 Travel Restrictions Increased in 2020

While the amount of travel decreased into Maine in 2020, according to Flickr VGI, those from places with Covid-19 travel restrictions decreased at higher rates than those from places exempt from restrictions. Interestingly, while the number of Flickr photos posted by visitors with travel restrictions decreased by 76% (Figure 3), the number of associated Flickr users from these restricted areas only decreased by 46% (Figure 5), indicating that visitors from restricted regions might have been traveling to Maine at a higher rate (30%) than the percentage of photographs they were posting. This potentially indicates a change in social media behavior as well as a change in travel patterns.

Travel patterns of Flickr users exempt from travel restrictions also indicate a potential change in social media use. When comparing the average number of Flickr users from 2013-2019 to 2020, Figure 6 shows that there was an increase of 17% in the proportion of exempt Flickr users in Maine in 2020 compared to

2013-2019. However, when compared to the 59% increase in the percentage of photos posted from these users (Figure 4), the number of photos increased 42% more than the number of users themselves. By posting a higher proportion of photos than was typical, this suggests travelers exempt from travel restrictions perhaps felt more legitimized in expressing their presence and connection to the destination through their social media usage, whereas travelers not exempt from travel restrictions did not. Thisprovides evidence that the details available through Flickr VGI can potentially give a much more accurate picture of social activity, visitor behavior, and who is actually traveling, than could be obtained from traditional datasets such as sales tax reports. These consumer behavior changes that are connected to travel restriction status are important to understand, as it could have implications for how well policies are working. This concept is explored further in density maps of geolocated Flickr user activity showing exactly where exempt and non-exempt travelers were travelling once inside Maine.
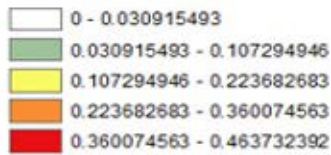
New information emerges in the geo-visualizations when comparing exempt and non-exempt travelers. Figure 7 shows density maps of Flickr photos posted in Maine from users traveling from places that were exempt from COVID-19 travel restrictions at some point from March to August of 2020 for 2013-2019 compared to the same users and timeframe for 2020. Like the previous photo-density maps from 2013-2019 (Figure 2), Flickr photos posted by users from places exempt from COVID-19 travel restrictions are mainly distributed along Maine's south-coast. However, in 2020 those from places exempt from COVID-19 travel restrictions seem to have expanded their travel into northern and rural Maine, with a new distinct hotspot around Baxter State Park, and northern, rural coastal communities. Photo distribution along the south coast shifts more south. There is also less of a hotspot at Acadia National Park when compared to other groups and times. Although there is a shift more north and rural, exempt travelers are still visiting somewhat popular tourist areas within Maine as their hotspots remain around known destinations like inland state parks.

Seen in Figure 8 are density maps of Flickr photos posted in Maine from users traveling from places that had COVID-19 travel restrictions to Maine from March to August of 2020 for 2013-2019 compared to the same users and timeframe for 2020. While the pre-Covid 19 distribution of photos follows the traditional travel pattern along the south coast of Maine to Acadia National Park, there is also a hot spot near the more northwestern rural Carrabassett Valley, a popular ski area. However, in 2020, while Acadia National Park is still a hotspot for these travelers, the pattern shifts to a much more dispersed rural, inland distribution, not directly connected to state and national park destinations within Maine, with photo densities all but disappearing along the south coast region of Maine except on the southern tip. This is a distinctly different travel pattern from the past and when compared to travelers without restrictions. Potential reasons for this are addressed in the discussion below and could be connected to the social and financial repercussions of travel during COVID-19.
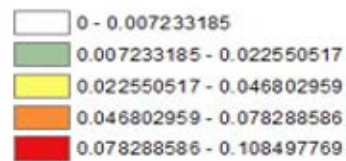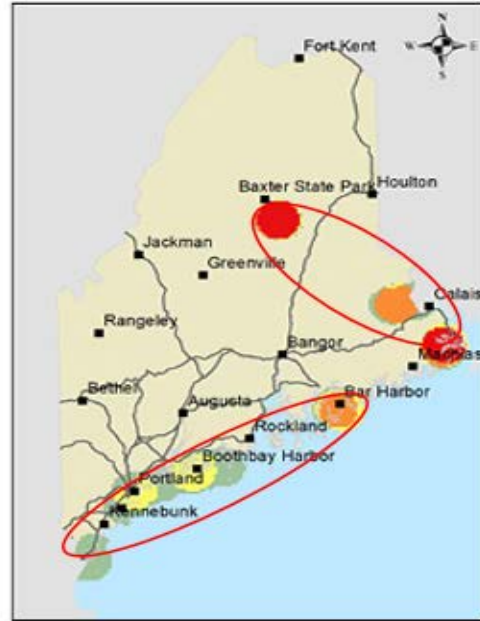
Figure 7:
Density Maps of Flickr Photos Posted in Maine from Users Exempt from COVID-19 Travel Restrictions Show a Shift Somewhat North, Rural and Inland in 2020
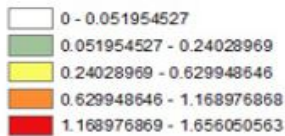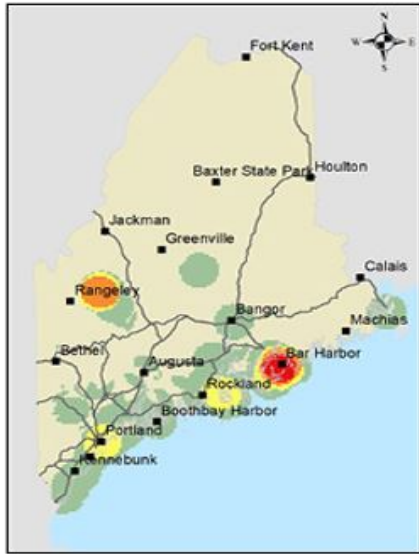

Note: Hot spots (highest photo density) are in orange and red. Circles indicate a continuation of traditional south coast travel patterns similar to 2013-2019 and a new northern, rural cluster (2020).
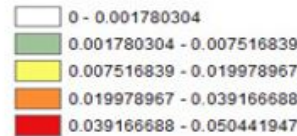
Figure 8:

Density Maps of Flickr Photos Posted in Maine from Users With Travel Restrictions Dispersed More North, Inland and Rural

Density map for all photos from users with travel restrictions 2013-2019.

Density map for all Photos from users with travel restrictions 2020.

0 - 0.051954527	0 - 0.001780304
0.051954527 - 0.24028969	0.001780304 - 0.007516839
0.24028969 - 0.629948646	0.007516839 - 0.019978967
0.629948646 - 1.168976868	0.019978967 - 0.039166688
1.168976869 - 1.656050563	0.039166688 - 0.050441947

Note: Hot spots (highest photo density) are in orange and red. Circle indicates a dispersed movement north, inland, and rural in 2020.

DISCUSSION AND IMPLICATIONS

Flickr VGI Uniquely Details a Shift in Tourist Movement into North, Inland and Rural Maine
As seen in this research, Flickr VGI is a valuable dataset and well positioned for investigations into the impacts of Covid-19 on Maine tourism. It corroborates not just a widely known decrease in visitors to Maine during the Covid-19 pandemic of 2020 (Figure 1), but geo-visualizations of this activity uniquely allowed details of this change to be investigated. Flickr density map visualizations proved to be particularly useful in assessing changing travel patterns within the state by connecting certain types of visitors to specific points in the destination.

Efforts to move more tourism into north, inland, rural areas of Maine have been ongoing for decades (Maine Office of Tourism, 2020) in order to create new economic opportunities in places recovering from the loss of manufacturing at the end of the previous century. COVID-19 brought distinct results for this movement within months. The density maps of Flickr photo locations in Figure 2 show that while visitors were still in Maine's traditionally popular south-coast tourism region, they were also spreading out into Maine's northern, rural, inland areas, in a way never before seen in modern history. These places offer more access to nature, fresh air, less built environments, and less people in general. This shift of visitors is perhaps attributed to the quest for natural, open spaces seen during the pandemic (Maine Office of Tourism, 2020) and could provide a key opportunity for needed economic development and tourism growth as Maine has

an extremely high revisit rate of 77% (Maine Office of Tourism, 2020). This could be the beginning of future opportunities for continuing tourism growth in these regions if local and state tourism stakeholders can work together in creating more infrastructure and increased marketing to bring back those travelers that "discovered" inland, rural, northern Maine for the first time during the pandemic. It is important to note that this movement also potentially contributes to the degradation of the environment due to lack of tourism infrastructure in these places, and this issue needs to be addressed as well.

Flickr VGI Indicates a Change in Social Media Behavior
Flickr photo proportions from users coming from regions with COVID-19 travel restrictions to Maine from March to August 2013-2020 saw a heightened decrease of 76% (see Figure 3) compared to those from regions exempt from travel restrictions at some point from March-August 2020, who saw a heightened increase in the proportion of photo posts by 59% (refer to Figure 4). For tourism management policy, it appears that Maine's COVID-19 travel restrictions on places deemed high risk succeeded in reducing travelers from those places, compared to those from places deemed lower risk and exempt from restrictions. However, once again Flickr VGI provides a more nuanced view of this pattern.

A comparison of Flickr user counts versus overall photo counts shows the amount of Flickr users coming into Maine likely did not change as much as the number of photos posted originally suggested. The proportion of photos posted by users from exempt regions increased by 42% more than the proportion of associated users increased (see Figure 5). Likewise, the proportion of Flickr photos from visitors with travel restrictions decreased 30% more than the number of associated users from these restricted areas (refer to Figure 6). Visitors from restricted places were not posting as many photos as in the past while those from non-restricted places were posting a higher proportion.

This decreased proportion of photo posts by Flickr users with travel restrictions in 2020 could be due to the heavy societal pressure not to travel during a time of public health uncertainty and the potential social and financial repercussions of restricted travel during the pandemic (Compton, 2020; Graham & Gray, 2020; Kenney, 2021; Rogers, 2021; Snow, 2020). Many destinations, like Maine, implemented fines for visitors violating travel restrictions in 2020. People who violated the Governor's coronavirus executive orders in Maine could face six months in jail and a $1,000 fine, although there were no known cases as of April 1, 2021 (State of Maine Office of Governor COVID-19 Response, n.d.). The threat of penalties however might have influenced social media behavior, for instance, if restricted travelers were not following the restrictions (quarantining for 14 days or showing proof of a negative COVID-19 test), they might be less likely to post photos of their travels than those without restrictions so as not to bring unwanted attention to themselves. Other societal pressure could be at play as well. Social confrontations between locals and visitors were noted in various destinations, including in Maine, with some visitors receiving negative or threatening notes due to their out-of-state license plates (Graham & Gray, 2020; Snow, 2020). This "travel shaming" phenomenon, where people are shamed, mostly online, for putting others at risk of COVID-19 exposure due to their travel, could make visitors less apt to post images of their travels on social media (Rogers, 2021). This is evidence that travel restriction policies could have an impact on tourist behavior beyond their movement into the State. It could influence social media behavior and the willingness of visitors to make a statement about their engagement with the destination. Therefore, travel restriction policies in Maine in 2020 might not have been as successful as the photo data might at first indicate, something that could have broader implications for policy makers and for researchers using VGI data as a proxy for social behavior during a time of public health crisis. This suggests that Flickr user counts as well as photo counts might be needed when determining movement of visitors subject to phenomena like travel shaming, or when trying to understand unintended consequences of travel restrictions and judge their success.

Visitors with Travel Restrictions Moved More Rural, Inland and North Than Those Without
Flickr geo-visualizations further broke down who was responsible for the shift to rural, northern, inland areas of Maine, data not otherwise available. Density maps show that visitors from places with travel restrictions (Figure 8) tended to travel farther away from the typical popular tourism spots along the south coast. These travelers had a much more dispersed spread into northern, rural areas on the Maine landscape in 2020 than those from places without restrictions (Figure 7). As suggested, with the heightened reduction of photo posts this group demonstrated, these visitors might have felt less comfortable traveling in popular tourist regions of Maine due to their restricted status and the associated social and financial repercussions mentioned above. The implications of this shift of visitors coming from more high-risk places into extremely rural, inland communities could ultimately put these areas more at risk for increased virus transmission and might warrant the re-evaluation of how travel restrictions are implemented and enforced at the state and regional level.

Limitations and Future Work
Although the results of this research suggest the utility of Flickr VGI in social geographic investigations of tourism during a time of rapid change, the study is subject to some limitations that could provide directions for future research. Like all technology-based protocols and social science research methodologies, there is potential for sampling bias. Owuor & Hochmair (2020) discuss user selection bias from various social media VGI platforms based on demographic factors, for example, "Twitter shows a bias towards male users and an under-sampling of Hispanic and African American users in certain regions of the United States" (p. 2). Demographic research indicates that social media users tend to be younger, more educated and earn higher incomes than those that do not (Di Minin et al., 2015, Li et al., 2013; Lo et al., 2011; Nov & Ye, 2010). Flickr users are typically well-traveled with a strong understanding of technology, and a larger share of Flickr users are professional photographers, compared with other photo-sharing platforms (Girardin et al., 2008). While the research described in this paper produced results in alignment with reported survey data from the Maine Office of Tourism (2020), in order to further mitigate this potential bias, future research could compare and correlate these patterns to other datasets such as hospitality sales and collect longitudinal data to see if the changed travel patterns noted in 2020 remain after the pandemic is over.

Additionally, this research uses a single social media platform (i.e., Flickr), which has a smaller user base than, for example, Twitter, Instagram or Facebook. Although Flickr data provides significant, free information about the location of social media user origin and movement in a destination, the numbers of people that post photos to the platform are lower than those using other social media websites. It should be noted that many popular social media platforms do not give public access to its users' metadata. Future research however could apply methods similar to those used in this study to analyze data extracted from other digital platforms with some public VGI such as Twitter, or cell phone records, recognizing it could be cumbersome and costly.

Finally, the data in this paper indicates that the concept of social stigma and social media use, as seen in the travel shaming phenomena, is worth future study especially as it applies to social media behavior during times of public health threats. Applying this research methodology in other destinations during atypical times, where factors such as travel shaming might be at play, would inform how and why social media usage might change and what that means for how VGI data analysis can inform tourism consumer behavior and concepts of social theory in tourism research.

CONCLUSIONS
While there are some limitations of Flickr VGI used, the immediate and robust tourist movement visualizations from this data makes distinct and valuable contributions to the study of social theory and photography in tourism geography. In this work, Flickr VGI provides evidence of the impact of travel

restrictions on tourist movement and social media behavior and suggests new travel patterns during the COVID-19 crisis. It reveals who is coming into a destination and is in a unique position to detail social activity such as how different types of travelers are behaving once there.

In Maine, during the COVID-19 pandemic, Flickr user counts and photo counts were starkly different than in the past and likely indicate a reduction in visitor social media use due to the potential social and financial repercussions of those coming from places with travel restrictions. Density maps show where different types of travelers were going in 2020 and how long-entrenched travel patterns changed. A shift in visitors more north, rural, and inland during the first six months of the pandemic offers the potential for new economic development that could benefit those regions. However, this could also mean increased environmental degradation and public health risk in these places, as it was discovered that more tourists from places with travel restrictions, due to high cases of COVID-19 from their places of origin, were visiting there.

For tourism planners, economists, and destination management organizations, visualizing these shifting patterns and accessing detailed consumer behavior data quickly with Flickr VGI can allow the adoption of more informed management strategies. These could include differing regional travel restriction policies, and increasing infrastructure or financial support, even if temporary, in communities seeing heightened tourism during a time of crisis. This would help preserve and protect the community, set the stage for future development, and better serve visitors. While the types of insights VGI provides can benefit any destination at any time, the changing visitor patterns in Maine seen in this research can be a useful guide for assessing COVID-19 impacts on travel into and within other rural, dichotomous destinations during a public health crisis, where mitigation and management policy has significant implications for health and well-being of people and places.

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