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Research note: Climate change and the demand for summer tourism on Minnesota's North Shore

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ABSTRACT

Very little outdoor recreation and tourism research uses scientifically-grounded climate change projections or weather data to predict future recreation demand using standard contingent behavior methods. The demand studies that have presented visitors with projected changes to climate and weather are limited to predicting visitation demand in a single season at a single destination. This research note reports a replication of a winter tourism demand model for the summer tourism season at the same nature-based tourism destination. A comparison of model findings between the two seasons allows us to determine if, and how, summer and winter tourism demand to a specific destination will be affected by climate change. While winter demand is driven by multiple dimensions of place meanings, summer travel is motivated solely by how the destination shapes individuals' identities. This replication also considers an additional weather variable – daily high temperature on the day visitors completed the survey – to better understand the relationship between in situ weather conditions and recreationists' intended travel behaviors.

Management implications:

- North Shore visitors' future travel behavior, contingent upon warmer temperatures and altered environmental conditions, was not significantly different than past travel behavior.
- The projected conditions presented in the scenarios might not have been severe enough that respondents believed they would substantially impact recreational opportunities on the North Shore.
- The maximum daily high temperature on the day a respondent was surveyed was not significantly related to contingent travel behaviors.
- Recreation resource managers and those in the tourism industry are not likely to see substantial shifts in tourism demand to the region over the next 20 years.

1. Introduction

The past decade has seen a rapid expansion of studies seeking to understand how climate change has and will affect tourism systems (Becken, 2013; Fang, Yin, & Wu, 2018). We know that shifting climatic conditions will alter individuals' decisions about where they travel, how long they stay, what activities they can or choose to participate in while at a destination, and how frequently they choose to visit a destination. Much of our understanding has been assembled through dozens of case studies in which tourists are asked to indicate their preferences for sites with alternative climatic conditions (and/or alternative climate-dependent environmental conditions) (Rosselló-Nadal, 2014). However, very few of these case studies have elicited future travel behaviors with scientifically-grounded projections of

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future climate and environmental conditions at a destination (Loomis & Richardson, 2006; Perry, Manning, Xiao, & Vallerie, 2018; Richardson & Loomis, 2004; Smith et al., 2016). Additionally, very little previous research has examined the influence of on-site weather conditions and recreationists' responses to questions about their future travel behaviors. The purpose of this research note is to determine if seasonal variations in projected climatic and environmental conditions affect demand differently within the same tourism system. We do this by fitting a tourism demand model, previously developed and applied to data collected from winter visitors to Minnesota's North Shore region, to summer visitors in the same region. We also introduce daily weather into the model to determine if future weather conditions influence visitors' intended travel behaviors to the region.

2. Literature review

The small body of literature that has elicited contingent travel behavior alongside scientifically-grounded projections of climate and environmental conditions at a specific destination includes a study of Rocky Mountain National Park visitors (Richardson & Loomis, 2004), a study of visitors to Vermont state parks (Perry et al., 2018), and a study of winter recreationists in Minnesota's North Shore region (Smith et al., 2016). In Rocky Mountain National Park, visitors were presented with climatic (temperature and precipitation) and environmental (trail and road access, wildlife populations, vegetation composition) conditions for both a baseline climate scenario and projected (regional-scale) climate scenarios derived from two global circulation models (Loomis & Richardson, 2006; Richardson & Loomis, 2004). Visitors were asked to provide the number of trips they had taken to the park over the previous 12 months and then how many more or fewer trips they would take in the future given the climatic and environmental conditions described in the hypothetical scenarios. Only a relatively small proportion of respondents indicated their visitation behavior would change under the projected climatic and environmental conditions. Although the authors note seasonal variations are quite likely given visitation to the park varies dramatically throughout the year (e.g., 87% of annual visitation occurs between May and October), the survey instrument focused on annual visitation (i.e., the total number of trips taken over the previous 12 months) and, as such, the authors could not assess if contingent visitation varied by season.

More recently, Perry et al. presented visitors to Vermont state parks with a range of projected summer climate (average daily high temperature, average daily low temperature, number of days with a temperature above 32.2 °C (90 °F), number of rainy days per week) and environmental (change in the number of biting insects) conditions. The projected summer climate and environmental conditions were derived from global circulation models downscaled to the spatial scale of the state (Betts, 2011). For variations of each condition (e.g., 3.5 °C (6 °F) above current average daily summer high temperatures), park visitors were prompted to indicate the extent to which they would take more or fewer trips in the future. The authors found average daily high and low temperatures would have relatively little effect on visitation. However, the number of summer days over 32.2 °C (90 °F) and the average number of rainy days per week would have a large negative effect (i.e., decrease) on visitation. Similar to the study conducted at Rocky Mountain National Park, Perry et al. were unable to determine if shifts in climatic conditions affect visitation similarly across different seasons throughout the year.

The final study to elicit contingent travel behavior with scientifically-grounded projections of climatic and environmental conditions was conducted using a sample of winter outdoor recreationists and tourists in the North Shore region of northern Minnesota (Smith et al., 2016). Winter visitors were presented with a table illustrating recent and projected climate (mean daily high and low temperatures, mean daily maximum and minimum wind chill temperatures) and environmental (mean daily snow depth, mean daily ice thickness at inland lakes) conditions. Projected climate and environmental conditions were derived from bias-corrected downscaled climate projections for the region (Thrasher et al., 2013). Winter visitors were asked to provide the number of trips they had taken or would take to the North Shore for the current winter season (December 1 – February 28) as well as the number of trips they would take to the region given the projected climate and environmental conditions presented in the survey. The authors found that, under the projected climatic and environmental conditions, visitors would take a similar number of trips as they reported for the current winter season.

The demand model constructed by Smith et al. (2016) also included several social-psychological variables believed to affect contingent travel behavior. Specifically, the model included measures of the place meanings visitors attach to the North Shore as covariates. Place meanings, which include individual identity, place dependence, and family identity, were all significantly and positively related to the number of trips a visitor would take in a climate-altered future. Yet, similar to the findings of other climate-dependent contingent travel behavior studies (Loomis & Richardson, 2006; Perry et al., 2018; Richardson & Loomis, 2004), Smith et al. were not able to determine if shifts in climatic conditions affect visitation similarly across different seasons throughout the year.

None of the aforementioned studies examined the influence of weather conditions on the day a respondent was asked about their future travel behaviors. A large body of research from outside of the tourism climatology literature suggests the weather on the day an individual is surveyed may affect how they respond to the survey. Several empirical investigations have found a significant and positive correlation between outdoor temperature on the day an individual completed a survey and their beliefs in global warming (Deryugina, 2013; Egan & Mullin, 2012; Hamilton & Stampone, 2013; Joireman, Barnes Truelove, & Duell, 2010; Li, Johnson, & Zaval, 2011; Zaval, Keenan, Johnson, & Weber, 2014). Additionally, warmer temperatures are related to tourism and recreation behavior. Generally, the literature states that as temperatures increase, visitation to parks and protected areas will also increase until average temperatures become uncomfortably hot (~30 °C) (e.g. Fisichelli, Schuurman, Monahan, & Ziesler, 2015; Scott, Jones, & Konopek, 2007), although regional variances are likely to occur based on tourism providers' capacity to adapt and visitors' past experiences and preferences (Smith, Wilkins, Gayle, & Lamborn, 2018). It is unclear if weather conditions on the day of a survey have any effect on responses to contingent travel behavior questions.

In this research note, we apply the winter tourism demand model developed by Smith et al. (2016) to a sample of summer visitors to the same tourism destination. By doing so, we are able to: 1) determine if seasonal variations in projected climatic and environmental conditions affect demand differently within the same tourism system; and 2) introduce daily weather as a covariate in the model. Through our second objective, we are able to empirically test the influence of weather conditions on visitors' intended future travel behaviors.

3. Methods

The North Shore of Minnesota is a nature-based tourism area along the coast of Lake Superior in northeastern Minnesota. The region is comprised of communities that are economically dependent on nature-based tourism and resource-extraction. We conducted surveys at 22 locations along the North Shore including eight Minnesota state parks; four scenic waysides; and a variety of local businesses, recreation areas, and historic sites. On-site questionnaires were administered to visitors at these locations using off-line survey administration software on tablet computers. Sampling took place from July 15 through August 3, 2015. A total of 2,453 respondents were intercepted during the sampling period, with 1,398 completing the questionnaire for a response rate of 57%. The response rate did not vary substantially +/- 10% across state parks, waysides and rest areas, private businesses, and

Table 1
Characteristics of surveyed visitors to Minnesota's North Shore.

Characteristic	Summer Visitors %	Summer Visitors Mean	Winter Visitors %	Winter Visitors Mean
Sociodemographic characteristic				
Gender				
Male	40.9		51.7	
Female	57.5		47.8	
Age				
18–24	10.8		14.9	
25–34	15.1		20.9	
35–44	23.2		17.7	
45–54	21.0		23.7	
55–64	19.7		16.5	
65+	8.9		6.4	
Education				
Less than high school	0.3		0.5	
High school	5.9		6.9	
Some college	14.9		13.9	
Associates degree	11.4		10.7	
Bachelor's degree	36.7		37.7	
Master's degree	23.6		22.1	
Doctorate	5.6		6.4	
Income				
< 10k	2.0		5.7	
10k-20k	2.3		3.8	
20k-30k	3.4		4.7	
30k-40k	5.6		4.8	
40k-50k	5.8		6.9	
50k-60k	7.0		6.0	
60k-70k	6.4		5.7	
70k-80k	8.6		5.7	
80k-90k	7.0		5.5	
90k-100k	7.9		9.4	
> 100k	30.0		32.6	
Psychological characteristics				
Place meanings				
Individual identity		3.7		3.7
Self-efficacy/place dependence		3.4		3.2
Family identity		3.6		3.5

other sampling locations (McCreary, Seekamp, Davenport, & Smith, 2017).

The survey collected visitors' sociodemographic data including their age, gender, level of education, and income (Table 1). Additionally, respondents' home zip codes were collected and used in conjunction with the survey intercept locations to calculate travel distance and costs associated with each respondent's visit. We also collected information about respondents' travel behavior; this included the number of trips the respondent had taken (or planned to make) during the current summer season (which was described as the three month period from June 1, 2015 to August 31, 2015). Weather data (high temperature, heat index, fire risk, and rainfall) recorded in a national database was added to the dataset for each sampling location and day. Because existing literature demonstrating the influence of daily high temperature on cognitive (e.g., climate change belief) and behavioral (e.g., demand shifts) responses, the daily high temperature variable was selected to be included in the model.

Respondents were also provided with projected climatic (number of days per month with an average high temperature above 21.7 °C (71 °F); number of days per month with a heat index exceeding 26.7 °C (80 °F); number of days with rainfall exceeding 0.25 in.) and environmental (number of days per month with high, very high, or extreme fire risk; the percentage of inland streams with brook trout and lakes with small mouth bass present) conditions for the region. Projections were developed using Coupled Model Intercomparison Project Phase 5 (CMIP5) estimates which use a range of Representative Concentration Pathways (RCP) that serve as future GHG emission trajectories. We used two RCP scenarios, RCP4.5 (moderate) and RCP8.5 (high) projected to 2035. The RCP scenarios were combined with two potential fire risk scenarios (high, very high, and extreme; and very high and extreme), as well as one potential scenario for future presence of brook trout and small mouth bass. A total of four scenarios were produced, as summarized in Table 2. To avoid systematic bias in responses to the contingent travel behavior questions, respondents were randomly selected to view only one of the four climate scenarios, which was displayed next to data showing recent trends (5-year average) for the same climatic and environmental variables. Respondents were asked to consider the future climate and environmental conditions and indicate the number of trips they would make to the North Shore in a hypothetical

Table 2
Future climate and environmental scenarios presented to summer outdoor recreationists and tourists on the North Shore.

	Recent conditions	Future Climate Scenario: RCP 4.5 showing days with very high and extreme fire risk $n=368$	RCP 4.5 showing days with high, very high and extreme fire risk $n=335$	RCP 8.5 showing days with very high and extreme fire risk $n=346$	RCP 8.5 showing days with high, very high and extreme fire risk $n=349$
Number of days each month with…	Number of summer days (% of summer days)				
an average high temperature above 21.7 °C (71 °F)	18 (60%)	19 (63%)	19 (63%)	21 (67%)	21 (67%)
a heat index above 26.7 °C (80 °F)	2 (5%)	5 (17%)	5 (17%)	6 (19%)	6 (19%)
Rainfall greater than 0.25 in.	5 (14%)	4 (12%)	4 (12%)	3 (11%)	3 (11%)
very high, or extreme fire risk	1 (2%)	n/a	7 (22%)	n/a	7 (22%)
high, very high, or extreme fire risk		11 (37%)	n/a	11 (37%)	n/a
Percentage of inland streams with…					
Brook trout	77%	20%	20%	20%	20%
Small mouth bass	53%	58%	58%	58%	58%

Note. Each respondent was presented with the recent conditions (average of data from the previous five years) and one future climate scenario, chosen at random. Respondents were informed the recent and future conditions were for the summer months only, defined as June 1st through August 31st. The Representative Concentration Pathways (RCP) scenarios are described in detail by van Vuuren et al. (2011). RCP4.5 represents a moderate warming scenario while RCP8.5 represents a high warming scenario.

future summer season (also described as the three month period from June 1 to August 31) with those conditions.

Place meanings, the emotional bonds between individuals and place, that respondents attribute to the North Shore were measured with nine statement items intended to measure three types (i.e., dimensions) of place meanings (Smith, Davenport, Anderson, & Leahy, 2011). The specific types of meanings were: *individual identity*, the extent to which individuals believe the North Shore shapes their personal identity; *family identity*, the extent to which an individual feels their family's shared memories or traditions depend on the North Shore; and *place dependence,* the extent to which an individual depends on the North Shore for unique recreation opportunities and experiences. A confirmatory factor analysis was used to test the convergent and discriminant validity of the nine-item place meaning scale.

Cases were removed from the data set if their self-reported primary purpose was not recreation on the North Shore (i.e., their primary purpose was business-related or other, $n = 143$) or if they opted to complete the survey online ($n = 113$), an option given to all potential respondents. We also removed respondents who reported excessive numbers of trips, truncated at three standard-deviations above the mean. Travel distance was truncated at the same threshold. These methods are consistent with the literature on travel cost modeling (Blaine, Lichtkoppler, Bader, Hartman, & Lucente, 2015). After cleaning the data, the final sample size was 1,158. Data were put into panel format with five panels representing current (revealed) travel behavior and contingent travel behavior under the four projected climate and environmental scenarios. Dummy variables were created for each of the five panels. The dependent variable was trip counts of past and potential future trips. The panel structure of the model allowed us to combine revealed and stated preference data. Given the overdispersion of our trip count variable, we utilized the negative binomial distribution. The model, adapted from Smith et al. (2016) is specified as:

$$Y_{ij} = \mu + \beta_{1-4} climate\_scenario_{ij} + \beta_{5-7} place\_meanings_i + \beta_8 high\_temperature_i + \beta_9 income_i + \beta_{10} travel\_cost_i + \varepsilon_{ij}$$

The dependent variable, Y_{ij}, is each respondent's (i) reported or estimated number of trips for each scenario (j). The independent variables include the four climate and environmental scenarios ($climate\_scenario_{ij}$), the factor scores for each of three place meaning dimensions ($place\_meanings_i$), the maximum temperature recorded on the survey date at the location where the respondent was intercepted ($high\_temperature_i$), the respondent's income ($income_i$), and their travel cost ($travel\_cost_i$). We include income in the model to control for individuals with different incomes making different travel choices.

4. Results and discussion

Summer visitors had similar sociodemographic characteristics and also exhibited similar levels of places meanings as did the winter visitors (Table 1, data on winter visitors from (Smith et al., 2016)). A detailed comparison of the two groups of visitors is provided in McCreary et al. (2017).

The majority (59.4%) of summer visitors spent fewer than 3 days visiting the North Shore. The average length of stay was 4 nights per visit ($\overline{x} = 3.74$, S.D. = 3.14) with the average respondent making around two trips ($\overline{x} = 1.63$, S.D. = 1.06) during the summer season. The majority (90.8%) of respondents participated in scenic driving and many indicated they went hiking (85.3%), visited a historic or cultural site (66.1%), went swimming (55%), picnicking (49.2%), or wildlife viewing (49%). Respondents travelled an average of about 250 miles ($\overline{x} = 247.46$, S.D. = 138.89 miles) with an average travel cost of US $423.01 (S.D. = 260.62). Daily high temperatures during the summer sampling period were on average 22.2 °C with a range from 17.2 °C to 80 °C (72 °F; 63 °F to 80 °F).

The results of the demand model (Table 3) reveal that contingent travel behavior was not significantly different than past travel behavior given any of the future climate scenarios. This finding is similar to other findings that various scenarios of climate change do not differentially influence travel behavior (Loomis & Richardson, 2006; Smith et al., 2016). This is also consistent with Perry et al. (2018) finding that high (and low) temperature are not significantly related to future travel behavior. A potential explanation for this finding is that the projected conditions presented in the scenarios were not severe enough that respondents believed they would substantially impact recreational opportunities on the North Shore. More focused research is needed in the future to determine if there are critical climate and environmental thresholds that would result in altered travel behavior. In this study, projecting to 2035 was deemed the most realistic planning horizon for the North Shore region.

Table 3
Results of population averaged negative binomial regression model predicting future summer trips to the North Shore.

Independent variables	β	S.E.	z	p
Future climate scenario				
RCP 4.5 with higher fire risk	0.056	0.031	1.82	0.069
RCP 4.5 with high fire risk	0.085	0.063	1.36	0.175
RCP 8.5 with higher fire risk	0.059	0.058	1.02	0.310
RCP 8.5 with high fire risk	0.005	0.030	0.17	0.861
Place meanings				
Individual identity	0.199	0.044	4.48	< 0.001
Self-efficacy/place dependence	0.046	0.045	1.04	0.298
Family identity	-0.037	0.036	-1.03	0.305
High temperature on day of survey	-0.001	0.001	-1.04	0.299
Income	-0.014	0.008	-1.65	0.098
Travel cost	$-5.7e^{-05}$	$9.29e^{-05}$	-0.61	0.539
Constant	0.639	0.069	9.27	< 0.001

The place meanings individuals derive from the North Shore are significantly correlated with contingent travel behavior. Specifically, individuals whose personal identities were more strongly tied to the North Shore indicated they would visit more often in the future as the region's climate and environment changes ($\beta = .199$, S.E. = .044, $p < .001$). However, place meanings associated with place dependence or family identity were not significant determinants of contingent travel behaviors for the summer season. These results are somewhat similar to those reported by Smith et al. (2016) who found that individual identity, as well as place dependence and family identity, were significantly and positively related to contingent winter visitation.

Finally, the maximum daily high temperature on the day a respondent was surveyed was not significantly related to contingent travel behaviors ($\beta = -.001$, S.E. = .001, $p = .299$). This finding suggests daily weather conditions, operationalized by daily high temperature, on the day of a survey do not affect responses to contingent travel behavior questions; this is despite the large body of research suggesting the outdoor temperature on the day an individual completed a survey is positively correlated with their beliefs in global warming and the literature suggesting outdoor temperatures are linked to tourism behavior in general (e.g. Scott et al. (2007),). As high temperatures on intercept days did not exceed 80 °F (27 °C), more research is needed to explore the influences of on-site weather conditions and visitors' responses to contingent travel behavior questions at locations with higher daily maximum temperatures.

5. Conclusions

This research note expands on the small body of literature that has elicited contingent travel behavior with scientifically-grounded projections of climatic and environmental conditions. Specifically, we have replicated and expanded upon the demand model developed by Smith et al. (2016). Our results are similar to the winter tourism demand model in that the effect of shifting climatic conditions on visitation was negligible and in that individual identity influences travel behavior. However, other place meaning constructs (family identity, place dependence) that were significant predictors for the winter season did not correlate with summer contingent travel behavior. Our findings suggest that some drivers of visitation demand vary depending on visitation season. Future research should explicitly consider how seasonality affects tourism demand, and more importantly the psychological drivers of tourism demand; our analysis highlights that these drivers are not always consistent across seasons. Our analysis also expands upon the literature by empirically testing if weather conditions on the day a visitor is surveyed influences their responses regarding their future travel behavior to the area. We found no relationship between the maximum daily high temperature on the day a respondent was surveyed and their contingent travel behaviors. Further research is needed to gain a better understanding of why daily high temperatures do not affect individuals' intentions to travel in the future under a warmer climate, even though they are demonstrated to impact individuals' belief in global warming. One potential explanation is that daily temperatures do not influence individuals' survey responses because individuals have a clear expectation of what the temperatures at their destination will be before they arrive, an anchoring effect (Chapman & Johnson, 2002). Temperatures may however, influence individuals' survey responses if those temperatures substantially deviate from expectations.

Our findings suggest that recreation resource managers and those in the tourism industry are not likely to see substantial shifts in tourism demand to the region over the next 20 years. Changes in climatic and environmental conditions beyond that time horizon however, may significantly alter the types and quality of outdoor recreation opportunities that the region can support. Preemptive planning and adaptation efforts on the part of resource managers and others in the tourism industry would be wise. Our findings also suggest that individuals whose personal identities are more strongly tied to the North Shore are more likely to keep making return visits as the region's climate and environment continues to change. Recreation resource managers and professionals in the tourism industry should actively seek out ways to encourage repeat visitation by those individuals whose personal identities are deeply intertwined with the region. Doing so, would help ensure consistent visitation numbers as many of the region's notable resources (e.g., trout) diminish. Proactive planning and adaptation efforts should include targeted marketing and communication strategies that can mitigate the long-term negative impacts of climate change on visitation to the region.

This research is not without limitations. First, we focus on shifts in visitation patterns among visitors who already travel to the North Shore region. Our analysis does not capture the possibility of new outdoor recreationists and tourists visiting the region for the first time due to the warmer temperatures or more desirable resource conditions. Another limitation is our inability to know which of the climate and environmental conditions presented to visitors were most salient to them as they considered their future trip-taking behavior. As de Freitas (1990) notes, outdoor recreationists and tourists make behavioral responses to a composite set of thermal, physical and aesthetic characteristics that define a setting. Our use of both climate and environmental conditions captures both thermal and physical characteristics of the North Shore. However, our approach has left a clear gap in the literature related to knowing how important each characteristic is in shaping individuals' trip-taking behavior. More research is needed on this front.

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