Water Quality and the Perception of Risk: A Study of Georgia, USA, Beachgoers

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1.1 Introduction

Under the BEACH ACT, the United States Environmental Protection Agency (EPA) mandates that states routinely monitor and promptly notify the public and local governments when beach water quality exceeds acceptable values (National Science Center for Environmental Publications (NSCEP), 2016). This study focuses on the perception of risk among Georgia (US state) beach visitors related to polluted water. Funded by the Georgia Department of Natural Resources, this research examines what conditions define coastal waters as being polluted for these visitors. Even though recreational beaches are potent tourism-driven economic engines, there is a paucity of data within the United States on beachgoers' risk perception and definition of a polluted beach. This study seeks to address the gap between routine beach water quality notifications and public awareness in coastal Georgia, USA.

1.2 Location and Economic Impact: The state of Georgia is unique among the fifty states. No part of the Georgia mainland directly fronts the ocean. Instead, a series of tidal and barrier islands separates the southeastern Georgia mainland and the Atlantic Ocean. These Sea Islands extend from Florida up the Atlantic Coast and into South Carolina. Historically these islands have been host to varied communities including the Guale Indians, Gullah/Geechee communities, colonial pirates, fishing industries, millionaire beach enclaves, the military, and contemporary tourists. Today the Sea Islands are popular tourist destinations with Glynn County, Georgia, marketing their local islands as the Golden Isles. With Georgia offering at the time of this study the largest tax credit in the U.S. to filmmakers, Georgia in 2015 tied with Louisiana as the third most common site for film production in the world after California (#1) and the United Kingdom (#2) (Hensley, 2016). As a result, historic Savannah and various coastal locations are increasingly featured in films.

The Georgia Department of Economic Development estimates 102 million tourists visited the state in 2015 including nearly a million overseas visitors. These visitors generated $61 billion in

spending in 2016 and supported more than 450,000 jobs (Georgia Department of Economic Development, 2017). A 2015 economic study of Tybee Island, the recreational beach destination closest to Savannah, finds the island's beaches draw 1,044,000 annual visitors who generate $93 million in on-island business revenue and $8.7 million in governmental revenue from sales taxes, lodging taxes, and parking fees. Analysis of spending comparing tourists from different areas (local people, Georgians from other parts of the state, and out-of-state tourists) finds per capita spending on Tybee is highest among Georgia residents from other parts of the state. Significantly, more than 60% of both local and non-local Georgia visitors as well as 49% of out-of-state visitors report they would go to beaches outside of the state if erosion or other forces took away Tybee's beaches (Barber, Beck, Mangee, Saadatmand, & Toma, 2015). Beaches are big business in Georgia with a large impact on the local and state economies.

1.3 Existing Research on Beach Users and Perception: Beach users expect certain experiences when visiting for recreational activities, and certain factors support or take away from these experiences. For example, the Tybee Island economic analysis quotes a visitor who was interviewed as she was leaving the beach because of a high tide: "Without a beach, what's the point?" (Barber et al., 2015). A British study similarly finds that beach users report beaches to be more restorative when the tide is low, temperatures are cooler, and air quality is better (Hipp & Ogunseitan, 2011). In a survey of beachgoers in Portugal, visitors report three key aspects to perceptions of beach quality: 1) water quality, 2) litter, and 3) safety. Visitors to more remote Portuguese beaches value scenic beauty more while visitors to that country's urban beaches report a desire for expanded facilities and parking (Vaz, Williams, Pereira, & Phillips, 2009). Similarly, while visitors to Spanish beaches identify the provision of beach facilities and equipment as components of beach quality, local residents emphasize retaining beaches in a more natural state and curbing crowding and environmental degradation. In this same study, visitors also were less disturbed by beach crowds which residents conversely identified crowds as taking away from beach quality (Roca, Villares, & Ortego, 2009).

Maintaining water quality and shorelines, however, is expensive and involves in Georgia a heavy burden of trash. For example, a 2015 study of 20 Georgia beach sites reports finding 180kg to 1,000kg of plastic debris on both heavily visited and remote beaches (Lee & Sanders, 2015). Yet there is an economic upside to investing in removing beach trash. One study computes that improving water clarity increases spending per visitor by around $50 and improving trash elimination from a beach increases spending by $98 per visitor (Loomis & Santiago, 2013).

From toddlers with dirty diapers to adults urinating while swimming offshore, humans and other animals (Converse et al., 2012) can create a toxic stew of pathogens for beachgoers. How humans use beach environments also influences water quality and health risks. Waterborne pathogens spike during swimming seasons on weekends when bather density is highest (Benevente & Aslan, 2015). Swimmers and individuals wading in the surf can also stir up pathogens in underwater sand and create their own non-point sources of pollution (Graczyk et al., 2010). One study also estimates that individuals who choose to swim in coastal waters will ingest 25-50 times the water of someone such as a kayaker who will have more limited contact with seawater (Dorevitch et al., 2011). As one would expect from greater exposure, swimmers also experience a significant increase in rashes and itching after being in seawater compared to non-swimmers. Interestingly, this difference is not found in individuals who swim in freshwater lakes or rivers (Yau, Wade, de Wilde, & Colford Jr., 2009).

Risk perceptions are known to vary among people. Prior research finds a perception division between local residents and visitors using beaches for recreational activities. Local residents tend to rate their local beach quality higher than do visitors. Local residents who are more attached to their community similarly rate local beaches higher than residents who are not as attached (Bonaiuto, Breakwell, & Cano, 1996). A British study drawing on qualitative focus groups also identifies that individuals approach issues of risks related to coastal bathing within a larger context of their personal ideas about power, authority, and trust (Langford, Georgiou, Bateman, Day, & Kerry Turner, 2000).

While there are numerous studies of the levels and types of waterborne pathogens collected in American recreational waters, there are relatively few published studies which we were able to identify on

what defines a 'polluted' beach to the public and how these beachgoers perceive their risk from waterborne pathogens. This particular study seeks to offer results drawn from beachgoers to the heavily visited Georgia Sea Islands' beaches.

2.1 Materials and Methods

Data collection for this study consisted of a quantitative survey asking beachgoers about their perceptions of risk, beach water quality, and beachgoers' demographics. Researchers recruited participants directly on Georgia recreational beaches using a paper survey as well as through social media (Facebook groups) using an online version of the survey. Data were collected in the summer swimming season of 2017 (June and July). In-person data collection took place on two major Georgia recreational beaches over multiple trips. This study was approved by the Georgia Southern University Institutional Review Board with participants' consent required to complete the survey.

Data were analyzed using IBM SPSS 23 (IBM, Armonk, NY) and ArcMap 10.4.1 (Esri, Redlands, CA). Analyses of different demographic categories were conducted using Chi-square, t-test, and simple linear regression procedures.

3.1 Results

3.2 Participants' Demographics: The analytic sample consists of 238 participants who report visiting a Georgia beach in the past three years. The large majority (90.5%) report Tybee Island (45.7%) or Jekyll Island (44.8%) as their most visited beach in the past three years. Most respondents report they are female (73.7%), non-Hispanic (96.6%), and white (90.0%). None are active duty military. A minority live within three miles of a Georgia beach all year (23.4%) or for a month or more each year (11.5%) with the majority visiting from outside coastal Georgia. Respondents are older (mean and median age 46), higher educated (74% have a college degree), and wealthier (median household income of $80,000-$89,999) than the corresponding U.S. average.

Four out of five (79%) participants live in Georgia (See Figure 1 in (Jones, Aslan, Trivedi, Olivas, & Hoffmann, 2018)). Another 13% reside out-of-state in one of 16 states reported by respondents. Eight percent of respondents chose to not report their zip code.

Insert Figure 1 Here

3.3 Perception of Risk: Almost all participants (98.3%) feel there are potential health risks associated with recreational activities in polluted beach water (See Table 1 in (Jones et al., 2018)). While almost 4 out of 5 respondents feel wound infections and gastrointestinal issues are potential health risks from polluted beach water, nearly half do not associate ear infections (swimmer's ear) with waterborne pathogens.

Insert Table 1 Here

3.4 What Defines Clean Beach Water: When asked what one factor best defines a beach as having clean water, respondents gave various responses (See Table 2 in (Jones et al., 2018)). From a public health perspective the best way to define clean beach water is the absence of disease-causing pathogens. Yet, slightly less than half (48.7%) chose the absence of waterborne pathogens in the water as the best defining factor for clean beach water. Nearly a quarter chose the absence of trash with another fifth viewing clear or colorless water as the best indicator of clean beach water. Odorless water (8.1%) and the absence of wildlife (0.4%) are less commonly chosen as the best indicators of clean beach water.

Insert Table 2 Here

The researchers also used statistical analysis to determine whether different demographic groups' responses to what defines clean beach water varied. Specifically, the researchers analyzed whether there was a difference in choosing the absence of waterborne pathogens as the best marker for clean beach

151 water. Results indeed do reveal a statistically significant difference for choosing the absence of disease-
152 causing pathogens as the best indicator for clean beach water in terms of education. Respondents with a
153 college degree are significantly more likely to view pathogen-free waters as the best indicator than
154 respondents without a college degree X^2 (1, n = 238) = 7.009, p = .008. On the other hand, analyses
155 found no statistically significant differences by sex, age, race, income, or Hispanic ethnicity.

156 **3.5 Comparing Visitors and Residents:** The survey asked respondents to categorize themselves as 1)
157 visitors, 2) residents for a month or more a year, and 3) year-round residents. Year-round residents are
158 significantly more likely to choose the absence of waterborne pathogens as the best indicator of clean
159 beach water than visitors X^2 (1, n = 185) = 6.874, p = .009. There is also a significant difference between
160 part-time residents and visitors X^2 (1, n = 157) = 4.457, p = .035 with part-time residents more likely to
161 choose the absence of waterborne pathogens as the best indicator of clean beach water. There is not,
162 however, a significant difference between part-time and year-round residents. Among visitors, the
163 majority (59.2%) rates visually clean or odorless water as better indicators of clean beach water than the
164 absence of disease-causing pathogens. Most year-round residents (61.8%) and part-time residents
165 (63.0%), however, rank the absence of waterborne pathogens as the best indicator.

166 **4.1 Discussion:** From a public health perspective, this study shows there is considerable education
167 needed among the general public about clean beach water. Almost all of the respondents say they are
168 aware that polluted waters can pose various health risks, but the majority of respondents rate visual and
169 odor aspects of beach water as better indicators than pathogen-free water.

170 Other studies have found key differences in how visitors and residents view their beach
171 experiences. While none of these other studies focused on perceived risk from polluted water, our
172 Georgia beach research indicates both year-round and part-time residents rate the absence of waterborne
173 pathogens as the key indicator of water quality. Perhaps because visitors come to the beaches for
174 vacations where they will have more limited exposure to the water, their preferred key indicators of clean
175 beach water are those that most immediately affect beach aesthetics. Residents may also be better

informed about beach water quality hazards and chose pathogen-free water because of their familiarity with the Department of Natural Resources advisory system.

On a positive note, the one demographic factor associated with ranking the absence of waterborne pathogens as the best indicator of clean beach water is education. Individuals with more education are more likely to rate waters free from disease-causing pathogens as the best indicator of clean beach water. If greater education in general improves perception of risk, then more targeted education with beachgoers about valuing pathogen-safe waters over aesthetics appears possible.

4.2 Limitations: This survey relies upon a convenience sample of beachgoers drawn from respondents visiting two particular Georgia beaches in the summer of 2017 and respondents willing to voluntarily complete an online questionnaire. Participants are older, better educated, wealthier, more female, and more non-Hispanic white than the population in general and thus lack the diversity of the population in general. Researchers also surveyed beachgoers only in the summer months, and there may be seasonal variations in the demographics and perspectives of beachgoers not captured in these data. Results may therefore not be representative of the population of Georgia beach visitors in general or beachgoers who visit Georgia beaches in seasons other than summer.

5.1 Conclusions: Living along a beach for all or part of a year influences residents to perceive clean beach water as pathogen-free water. Short-term visitors, however, rate aesthetic factors such as smell and the absence of litter above health risks. Higher educated individuals among residents and visitors alike, however, rate pathogen-free water as more important than aesthetics. Beach managers and local health departments need to invest in ways to educate the public –especially short-term visitors- about routine testing, health risks, beach notifications, and the importance of pathogen-free waters.

6.1 Acknowledgements: This work was supported under grant award # NA15NOS4190160 to the Georgia Department of Natural Resources (DNR) from the Office of Ocean and Coastal Management (OCRM), National Oceanic and Atmospheric Administration (NOAA). The statements, findings, conclusion and recommendations are those the author(s) and do not necessarily reflect the views of DNR, OCRM or NOAA. The authors would like to thank Elizabeth Cheney and Stefanie Nagid with the Georgia Department of Natural Resources for their kind assistance and support for this research.

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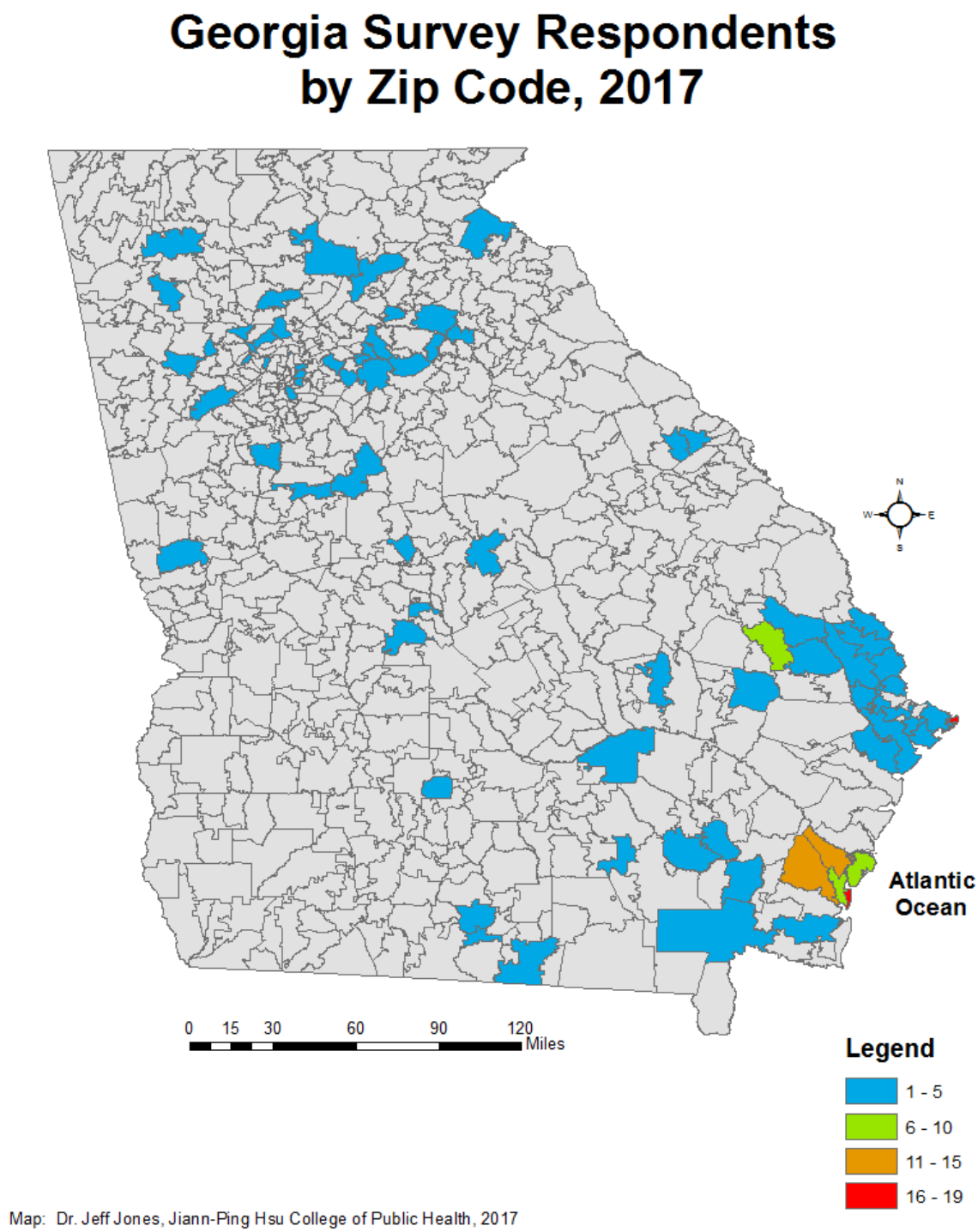
In Respondent's Opinion, This Health Risk Is Associated with Recreational Activities in Polluted Beach Water	Percent Responding YES
No Risks	**1.7%**
Upset Stomach/Diarrhea	**79.4%**
Swimmer's Ear	**52.9%**
Red, Itchy Eyes/Eye Infections	**71.4%**
Wound Infections	**79.8%**

Table 1

Table 2

This Factor BEST Explains What Clean Beach Water Means to a Respondent	Percent Responding YES
No disease-causing pathogens in the water	48.7%
No trash	23.7%
Clear or colorless water	19.1%
Odorless water	8.1%
No wildlife	0.4%

Figure 1



Map: Dr. Jeff Jones, Jiann-Ping Hsu College of Public Health, 2017

Highlights

- While the majority of beach residents view the absence of disease-causing pathogens as the best indicator of beach water quality, most non-resident visitors to Georgia beaches rate aesthetic factors such as the absence of trash, odors, and murky water as the best indicators.

- Beachgoers with a college degree are more likely to rate the absence of waterborne pathogens as the best indicator of beach water quality.

- 98.3% of beachgoers say there are health risks from polluted waters with wound infections (79.8%), diarrhea (79.4%), eye infections (71.4%), and swimmer's ear (52.9%) identified as health risks.