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Surf's up? How does water quality risk impact surfer decisions?

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ABSTRACT

Water quality and the subsequent beach advisories resulting from impaired quality are significant problems throughout the world and specifically in the Gulf of Maine where our study took place. Surfers represent a culturally and economically important subpopulation of beachgoers who are subject to higher risks associated with impaired water quality. This increased risk is related to the amount of time surfers spend in the water, the higher incidence of water ingestion, and the propensity for surfers to surf around storm events when water quality is the lowest.

In our research we surveyed 291 surfers and conducted 20 interviews with gatekeepers in the surfing community in the Gulf of Maine. We found that given the level of environmental exposure coupled with a strong sense of environmental sustainability within the local surfing community, Maine and New Hampshire surfers provide valuable insight on issues of water quality. We find that surfers indicate that water quality and pollution can impact an individual's decision to surf. Given this, surfers should have equal accesses to water quality information at their local surf spots. Surfer's knowledge can prove useful to researchers and help drive policy changes related to water quality management.

1. Introduction

Coastal areas and communities are some of the most vulnerable regions worldwide. In addition to being home to 44% of the world's population (United Nations Atlas of the Oceans, 2010), coastal regions are likely to be significantly impacted by climate change and the advent of sea level rise (Nicholls and Cazenave, 2010). A changing climate has already led to increases in water temperatures and water quality concerns globally and in our case study region of the Gulf of Maine (Pershing et al., 2015). The coastal regions of our world face challenges such as saltwater inundation (Barlow and Reichard, 2010), coastal erosion and beach loss (Zhang et al., 2004), and excess nutrients flowing off the land and polluting coastal waters (Rabalais et al., 2009). Indeed, coastal water quality is a growing issue worldwide (Gilbert et al., 2006). Impaired coastal water quality not only has implications on natural plant and animal communities, but also has significant impacts on the human dimension. Impaired coastal water quality can cause closures in shellfish and other fisheries and as well as advisories and closures on recreational beaches (Grant and Sanders, 2010; Given et al., 2006; Glasoe and Christy, 2004; Boehm et al., 2009).

Beach recreation is one of the most popular American pastime with an estimated 96 million people taking at least one trip to a beach each year, according to the most recent data available (Pergams and Zaradic, 2008). Despite its chilly reputation, the northern New England region of southern Maine and New Hampshire is a popular beach hub for the surrounding areas. The significance of tourism to the coastal economy is notable, representing 64.7% of the ocean economy jobs in Maine and 43% of the ocean economy jobs in New Hampshire (NOEP, 2014). Combined, the coastal zone in Maine and New Hampshire contributes $3.8 billion to the states' GDP and an additional $2.2 billion in wages (NOEP, 2014). Surfers play an active socio-economic role in coastal communities (Lazarow et al., 2009; Slotkin et al., 2009; Lazarow, 2007; Nelsen et al., 2007). Nationally, there are 2.5 million surfers-up from 1.8 million in 2004 - according to recent statistics from the Surf Industry Manufacturers Association (Saul 2016). Though surfers represent only a small population of total beachgoers, they average almost twice as many visits per year (Leeworthy and Wiley, 2001).

Maintaining and preserving beach water quality is important for the continued and sustained use of coastal beaches. Not only do coastal systems provide ecosystem services and natural habitats they also produce important socio-economic benefits for costal residents and tourists alike. Noting the importance of clean coastal recreational waters, the United States Environmental Protection Agency (USEPA) passed the BEACH Act in 2000. This Act placed more stringent standards on coastal water quality with specific attention to pathogens that are harmful to human health (Boehm et al., 2009). Through the implementation of monitoring standards EPA decreased the water quality risk and potential human health implications for the average

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beachgoer. The level of water quality risk can differ between groups of beachgoers; for instance, young children tend to be more susceptible to the harmful pathogens associated poor water quality (Wade et al., 2003). In addition to inhabiting coastal waters, levels of pathogen have also been found in the sand (Heaney et al., 2012) and seaweed (Quilliam et al., 2014). However, the greatest risk for exposure to harmful pathogens occurs in beach-going populations who chose recreation activities that involve water contact such as swimming, bathing, or surfing.

Among these activities, surfers are arguably more at risk to impaired water quality for a number of reasons. Compared to other beachgoers, surfers frequent beaches more often and spend longer periods of time in the water (Turbow et al., 2003). Surfers surf year round, especially in the northeast where the surf conditions tend to be better during the winter months. There is evidence that some regions experience more rainfall and poorer water quality during these 'off' months (Bradley and Hancock, 2003). Surfers also tend to surf during and after storm events when the waves are the best, but the water quality is at its lowest (Tseng and Jiang, 2012; Nelsen et al., 2007; Bradley and Hancock, 2003). Lastly, surfers are more apt to ingest water or get cuts or scrapes through which microbial pathogens can enter (Tseng and Jiang, 2012; Stone et al., 2008). For these reasons, surfers are more at risk for issues associated with water quality.

Though not extensively studied, there has been some research pertaining to surfers' exposure to the risk of impaired water quality. These studies have shown that there is higher incidence of illness in surfers when compared to other beachgoers and that this is likely influenced by the amount of ingested seawater (Tseng and Jiang, 2012; Stone et al., 2008). Furthermore, Harding et al. (2015) investigated the relationship between risky surf behaviors such as surfing near an outflow or surfing after storms and an increased incidence in self-reported illnesses. This knowledge, along with the growing body of literature on illness caused by exposure to coastal waters (Tseng and Jiang, 2012; Turbow et al., 2003; Dwight et al., 2004), illustrate the need for a greater understanding of risky surf behaviors and decision making processes in the surfing community as to lessen the incidence of illness and ensure the safety for all water recreators.

With the focus on human health impacts, questions arise as to what surfers consider to be risky and do any of these risks impact a surfers' decision to enter the water? Risks that are commonly associated with surfing include injury, drowning, sharks and other sea life, and other surfers in the water (Nathanson, 2012). Surfing also has the reputation for being a risky sport. Some have argued though that this associated risk comes from the thrill seeking or 'surfing high' that is an experience of some surfing participants (Stranger, 1999). However, though surfing is perceived as a risky sport (Stranger, 1999) there is evidence that compared to other sports it has a relatively low risk of injuries (Taylor et al., 2004). There are few studies that actively examine risk and decision making in the surfing community as it relates to coastal management. To the best of the authors' knowledge this study is the first of its kind investigating what surfers in the northeast United States perceive as risky, whether they consider water quality a risk, and whether or not this impacts surfers' decision to enter the water and how scientists and policy-makers might engage with and communicate better with this vulnerable group.

Knowledge of beachgoers' behavior in response to water quality is important information for beach managers and policy makers. This research will help to improve risk communication to a particularly vulnerable group so that they are able to make more informed decisions on when to enter the water. Risk communication is an effort to ensure individuals can make informed decisions (Morgan and Granger, 2002). It relies upon appropriate, comprehensible, and available communication methods for all users and requires an effective message for success. The lack of effective risk communication can degrade trust and empowerment in a stakeholder group, which in turn can create opportunity for conflict (Morgan and Granger, 2002). Unbiased and trustworthy risk communication is an effective tool for stakeholders and other users to make more informed decisions regarding risk, in our case the risk of surfing during periods of poor water quality. An understanding of the perception of risk and decision-making in the particularly risk prone group of surfers not only sheds light on an understudied population in the Gulf of Maine but also yields knowledge around the issue of beach users' perceptions of water quality risk and whether or not this impacts a surfers' decision to surf. This knowledge will provide valuable insights for beach managers and policy makers to improve future risk communication so that all beach goers can make informed decisions about when to enter the water.

2. Methods

2.1. Study area

This research focused on 12 surf beaches in the Gulf of Maine from May 2015 to October 2015. The Gulf of Maine is of particular interest because of the lack of data in this region and the fact that its waters are warming faster than 99% of the world's oceans (Pershing et al., 2015) making it at the epicenter of a changing climate's impacts on the oceans. Of the surfable beaches included in the study 7 beaches are located in southern Maine and 5 beaches are in New Hampshire. The beaches of southern Maine and New Hampshire are popular tourist destinations during the summer months (MHB, 2015; Pesch and Wells, 2004).

The economic impact of the coastal tourist economy is significant for both Maine and New Hampshire. It is estimated that tourists contribute respectively $1.2 billion and $256 million to the Maine and New Hampshire coastal economies (NOEP, 2014). While southern Maine and New Hampshire are geographically close, the two states have significant differences in beach water quality. In their 2013 report, the National Resource Defense Council (NRDC) ranked the 30 states with coastline by beach water quality based on the national Beach Action Value (BAV) safety threshold (Dorfman and Haren, 2013). In the report New Hampshire ranked 2nd for the cleanest beaches while Maine was ranked 27th, three shy from having the least clean beaches in the nation (Dorfman and Haren, 2013). The beaches included in our study demonstrate this contrast (Table 1).

During our data collection period (May-October 2015) there were 47 advisories issued at the study beaches in Maine and 0 issued in New Hampshire (Table 1). It should be noted that beach management varies between the two states. In Maine the Maine Healthy Beaches program is responsible for water quality testing and beach advisories. Maine Healthy Beaches is funded by the State but heavily reliant on volunteers

Table 1
National Resource Defense Council Beach Action Value (BAV) exceedances for 2013 and number of issued beach advisories for 2015 (Dorfman and Haren, 2013; MHB, 2015; NHDES, 2015).

Beaches	Percent BAV exceedance	Number of advisories
New Hampshire		
Jenness	0%	0
Bass	4%	0
North Hampton	1%	0
The Wall	1%	0
Seabrook	0%	0
Maine		
Higgins	19%	12
Old Orchard	10%	3
Fortune's Rock	0%	0
Gooch's	38%	14
Wells	22%	3
Ogunquit	n/a[a]	0
Long Sands	22%	15

[a] NRCD percent BAV exceedance was not available for this beach.