Risk Perceptions of Tick-Borne Diseases in Maine: Surveying Outdoor Enthusiasts

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RISK PERCEPTIONS OF TICK-BORNE DISEASES IN MAINE: SURVEYING OUTDOOR ENTHUSIASTS

By

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B.A. Tulane University, 2015

M.S. Boston University, 2018

A THESIS

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Advisory Committee:

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Tick-borne diseases (TBDs) are a growing concern throughout the United States. Maine’s reliance on nature-based tourism as an industry and its proximity to the epicenter of Lyme disease in the northeast makes the state vulnerable to the negative consequences related to further spread of TBDs. Acadia National Park and the state’s recreational areas should be a focus of tick-disease-related research because of the influx of visitors to natural areas during the summer and fall -- the seasons that correlate with the majority of tick-borne infections. In 2019 alone Acadia National Park received nearly 3.5 million visitors, making the park one of the most visited in the United States National Park system (National Park Service, 2019). Previous research has evaluated risk perceptions related to tick-borne diseases, but there are limited contemporary studies in Maine. Understanding how Maine resident and non-resident outdoor recreationists evaluate the risk of tick-borne diseases and their behavior choices related to protective measures against these diseases is crucial to creating future intervention plans. This study included two different components; the first involved the statistical analysis of previously-collected survey data on Acadia National Park visitor tick-borne disease perception and behaviors. Data were collected during the summer-early fall 2019 seasons. Visitors were categorized into two distinct groups: those from areas endemic for Lyme disease and those from
regions not endemic for Lyme. Results showed statistically significant differences in perceived risk of tick-borne diseases and tick-preventive behaviors between groups. This thesis also focused on the implementation of an additional online survey instrument that targeted Maine outdoor recreationists--Maine residents that participate in outdoor recreation activities. Analyses were conducted to explore differences in risk perceptions, trust, and behaviors based on political affiliation. Significant differences in knowledge and informational trust were documented between members of separate groups. The final component included a comparative analysis of Maine residents and non-residents suing data from both surveys. Further significant differences were found between the two groups, including differences in perceived barriers, utilization of certain protective measures, and overall perceived risk. This thesis aims to (1) expand understanding of differences that may exist among groups in terms of knowledge, tick-borne disease preventive behavior, and risk perceptions in the context of TBD, (2) help identify gaps in knowledge of tick-borne diseases of outdoor recreationists, and (3) inform further measures to enhance the effectiveness of communication tools and identify potential communication strategies in the state of Maine.
DEDICATION

I dedicate this thesis to my family, without whom I would not have gotten to where I am today.
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LIST OF ABBREVIATIONS

Acadia National Park = ANP

Tick-Borne Diseases = TBD

Health Belief Model = HBM

Zoonotic Disease Risk Information and Processing Model = ZDRISP

Lyme Disease = LD

Mount Desert Island = MDI
CHAPTER 1
INTRODUCTION AND ORGANIZATION OF THESIS

This thesis aims to provide an understanding of knowledge about tick-borne disease, factors that influence tick-borne disease risk perceptions and specific protective behaviors performed by outdoor enthusiasts. As rates of infectious disease rapidly increase worldwide, it is crucial for the public to uptake additional protective behaviors, especially for diseases with clear preventive measures, such as those transmitted by ticks. Persons who recreate outdoors, hereby referred to as outdoor recreationists, are at heightened risk of contracting tick-borne diseases due to increased tendency of exposure. Considering that outdoor recreation is an important cultural value and a large contributor to Maine’s economy (Maine State Comprehensive Outdoor Recreation Plan, 2020), an influx of disease could be devastating from health, economic, and cultural standpoints. Therefore, understanding the perceptions of tick-borne diseases and travel behavior amongst resident and non-resident recreationists within the state can have important implications for not only future public health but also tourism sustainability.

1.1. Rationale and Significance

Tick-borne diseases are a large concern in Maine and much of the United States, and data trends point towards increasing infection rates in the future (Eisen et al., 2017; Johnson et al., 2017; Nelson et al., 2015; Robert et al., 2019; Smith et al., 2019). It is of paramount importance to understand not only the disease dynamics and epidemiology of tick-borne diseases but also to grasp how different factors influence stakeholders’ risk perceptions concerning TBDs, and how corresponding risk perceptions alter behaviors and therefore exposure risk. Several studies
(Aenishaenslin et al., 2014; 2015; 2016) found that Lyme disease risk perceptions are a key factor in increasing the publics’ acceptability of tick disease intervention methods. Bayles (2015) additionally highlighted the differences in risk perceptions of respondents in rural areas compared to urban regions, citing the importance of targeted public health interventions using information from risk perception studies. Butler et al., (2017), found that increased tick disease knowledge correlated with performing tick checks, but reported that further information is necessary to understand barriers to tick disease preventive behaviors. Each of our surveys will provide information that can increase understanding of how different respondents perceive TBD risk and what are the major barriers to adopting preventive behaviors.

Few studies have attempted to compare risk perceptions of TBDs of outdoor recreationists from out-of-state and in-state, and the literature regarding this objective in the state of Maine is particularly sparse. A previous survey (De Urioste-Stone et al., 2016) found that increased risk of tick-borne diseases was a concern to visitors to Acadia National Park and Mount Desert Island, suggesting the need for further evaluation of this topic. Another study (Robert et al., 2019) investigated the actual vs. perceived burden of tick-borne diseases in Maine communities. A few studies examining predisposing factors—the variables that influence greater uptake of protective measures-- for Lyme disease prevention techniques have also included Maine residents in their surveys, but these have not focused on outdoor recreationists (Herrington Jr. et al., 1997; Herrington Jr., 2004). Consequently, our study can fill in this apparent gap in research.

Using the data previously collected in Acadia National Park through a survey of mostly out-of-state visitors as well as a 2020 survey tailored towards Maine resident outdoor recreationists, we will better understand information gaps related to tick-borne diseases, barriers
to adoption of protective measures, and other knowledge directly related to risk perceptions of disease. By identifying gaps in knowledge of visitors within the park, National Park Service (NPS) managers can better determine potential visitor management strategies to use in order to lower the TBD risk of exposure within Acadia. By comparing the results of the out-of-state visitor vs. local resident recreation surveys, we will have a stronger idea of how recreationists in Maine perceive and respond to tick-borne disease risk while recreating in natural settings. Therefore, we can identify future communication steps and inform further research.

1.2. Lyme and other Tick-Borne Diseases

Prioritizing the study of infectious diseases, such as tick-borne diseases, is crucial for global public health. Maine, in particular, has seen increased rates of tick-borne disease infections such as Lyme disease (Smith et al., 2019; Maine CDC, 2020). Other tick-borne diseases such as Anaplasmosis, Babesiosis, Ehrlichiosis, and Powassan virus are becoming more common and should be cause for improved communication and management intervention strategies. Figure 1.1 below shows the reported cases of Lyme disease in 2018, with each dot representing one individual case. Anaplasmosis, Babesiosis, and Powassan virus are all transmitted by the black-legged tick, while Ehrlichiosis is carried by the Lone Star Tick (*Amblyomma americanum*, Linnaeus 1758). From 2013 to 2017, the cases of Anaplasmosis and Babesiosis in the state of Maine rose exponentially by 600 percent (Elias and Birkel, 2019). The Lone Star Tick is commonly found in the southeast United States, but is expected to become common in the Northeast in the near future (Bloemer, Zimmerman, and Fairbanks, 1988; Eisen and Eisen, 2018; Maine CDC, 2020).
Figure 1.1: Reported cases of Lyme Disease incidence- 2018. Image from Centers for Disease Control (2018)

Lyme disease is caused by the bacterial spirochete Borrelia burgdorferi and is transmitted through the bite of its primary vector, the black-legged tick (*Ixodes scapularis*, Say 1821). In popular culture, this species is often mistakenly referred to as the deer-tick. Lyme is endemic to many states in the Northeast, including Maine, and is becoming more prevalent in certain Midwestern states. Typical clinical manifestations of Lyme disease begin with the occurrence of a “bulls-eye” rash, Erythema migrans. These expanding rashes are present in 90 percent of reported cases (Dandache and Nadelman, 2008; Steere et al., 1977). Lyme is highly treatable if diagnosed early in its onset, but if treatment is delayed, long-term chronic effects have been reported (Marques, 2008). These negative health effects are commonly referred to as post-Lyme syndrome or chronic Lyme disease, although the latter terminology is controversial (Lantos,
Complications usually manifest in the form of debilitating arthritis, and in rare circumstances, neurological problems (Franz and Krause, 2003; Pfister and Rupprecht, 2006).

The primary reservoir host for the black-legged tick is the white-footed mouse, *Peromyscus leucopus*, Rafinesque 1818, and not the white-tailed deer (*Odocoileus virginianus*, Zimmermann 1780) (Ostfeld et al., 2006; Ostfeld et al., 2018). Still, the white-tailed deer is considered important for the reproduction of black-legged ticks because of their ability to support high tick loads and their inability to properly groom ticks off of their fur (Elias, 2019). Both white-footed mice and white-tailed deer are well suited to life in Maine and share the same habitats of mixed woodlands. They commonly occur in areas where forest edges meet suburban landscapes (Ostfeld et al., 2018; Wood and Lafferty, 2013). In addition, Schaub et al. (2015) and Ostfeld et al. (2006) found correlations between increased tick presence and acorn mast years. Climate change and habitat fragmentation have also been cited as contributors to the increase in tick abundance and expansion of their distribution range, and hence, leading to spread of tick-borne diseases (Dong et al., 2020; Tran and Waller, 2013). In Maine, black-legged ticks are found throughout the state, but most confirmed cases of Lyme Disease are reported from the southern and mid-coast counties (Maine CDC, 2020).

Blacklegged ticks have a two-year life cycle, with some variance dependent on geographic location (Kochan, de la Fuente, and Coburn, 2015; Telford et al., 2008). This cycle is illustrated in Figure 1.2 below. *I. scapularis* goes through three distinct molting stages from an egg into larvae, then enters a nymphal stage, and before finally molting into an adult. Uniquely, the species also feeds on three separate hosts during this time period. Black-legged ticks are not born with the pathogen that causes Lyme, but rather they pick up the bacteria during their larvae stage, when they feed on primarily white-footed mouse hosts and molt into their nymphal stages.
Figure 1.2: The life-cycle of the black-legged tick. Image from the Centers for Disease Control, 2019

(Keirans et al., 1996; Ostfeld et al., 2018). The nymphal stages are most active in late spring and early summer, usually transmitting the Lyme pathogen to humans during this time (Bouchard et al., 2011). Nymphs then proceed to take an additional blood meal, usually from a larger host such as a white-tailed deer, and molt into their final adult and reproductive stage. Adult black-legged ticks are most active during the September-November autumnal season (Piesman et al., 2002).

1.3. Tourism in Maine

Tourism is an important industry in Maine, attracting over 5.5 billion visitors per year that support local economies of many rural communities throughout the state. Tourism-related jobs supported nearly 110,000 Mainers, and an estimated 22 million tourists generated over $6.5 billion in revenue (Maine Office of Tourism, 2020). The tourism industry in Maine consists of
eight regions illustrated in Figure 1.3 below. These regions consist of Aroostook County, Downeast and Acadia, the Maine Highlands, Kennebec and the Moose River Valley, the Maine Lakes and Mountains region, the Mid-Coast, Greater Portland and Casco Bay, and the Maine Beaches region. As of 2019, the top three direct spending regions of overnight visitation were the Maine Beaches region, Downeast and Acadia, and the Greater Portland and Casco Bay area (Maine Office of Tourism, 2020). A total of 43 percent of overnight non-water recreational visitors were younger than the age of 45, compared to 33 percent of water-based recreationists (Maine Office of Tourism, 2019). Out of all overnight visitors that completed active, non-water activities, 63 percent mentioned hiking, climbing, or backpacking as their preferred recreational choice (Maine Office of Tourism, 2019). In the Downeast region containing Acadia National Park, 74 percent of those visitors surveyed cited hiking as their number one reason for visiting the area (Maine Office of Tourism Regional Insight Report, 2020). Maine also may continue to experience an influx of out-of-state residents relocating to Maine full-time, retire, or to purchase a second home. A total of 65 percent of mid-Atlantic respondents surveyed replied that they will consider moving to Maine after their trip, compared to a similarly high 63 percent of visitors from other New England states (Maine Office of Tourism, 2020).

**Figure 1.3:** Map of Maine tourism regions. Image from Explore Maine (retrieved 2020)
1.4. Theories of Risk Perception

The evaluation of risk perceptions in disease systems is relatively well-studied in health-based research, even in zoonotic disease systems (Clarke, 2009; Decker et al., 2010; Triezenberg et al., 2014). However, there is a gap in research looking at risk perceptions of tick-borne diseases in Maine between two different groups of stakeholders: residents who recreate and out-of-state recreationists. In order to do so, we will utilize constructs from the Health Belief Model (Bayles, 2013) and the zoonotic disease risk information seeking and processing model (ZDRISP; Clarke, 2009). These theoretical models will be further discussed in the subsequent pages. Further factors related to risk perceptions will be elaborated upon in chapter two.

1.4.1. The Health Belief Model

The Health Belief Model (HBM; Janz N.K. et al., 2002) has been widely utilized in research evaluating various health-related hypotheses. The model was first developed in the early 1950s as an attempt to understand why individuals failed to participate in disease diagnostic and prevention campaigns (Champion and Skinner, 2008; Rosenstock, 1960; Rosenstock, 1974). It was later adapted to test hypotheses examining best intervention practices to shift health behavior patterns (Clarke, 2000; Green and Murphy, 2014; Rosenstock, Strecher, and Becker, 1994). As illustrated in Figure 1.4 below, the individual beliefs of the HBM model propose that humans will engage in health interventions and shift behavior if they believe they are vulnerable (perceived susceptibility), if they expect serious consequences (perceived severity), if they believe that behavioral change will help them avoid the issue (perceived benefits), and/or if they deem the benefit gains greater than the obstacle costs (perceived barriers) (Bosch et al., 2010). In addition, the model addresses perceived self-efficacy, defined as an individual’s belief in their
own abilities to adapt to recommended actions, while perceived threat is the immediacy of the risk or danger (in our case, tick-borne disease exposure) in question. Modifying factors refer to the different demographic variables that influence individual beliefs, including age, gender, ethnicity, personality, socioeconomics, and pre-existing knowledge. These can also be described as sociodemographic variables. The modifying factors in combination with individual beliefs lead to actions, which in the HBM model entails a shift in behaviors (Bosch et al., 2010). Cues to action are the factors that influence a person to adopt those new behaviors in the first place.

Hall (2012) used the HBM to predict contraceptive behaviors and sexual health risks in women, whereas various researchers have documented the HBM model’s use in breast cancer detection and education campaigns (Champion, 1987; Norman and Brain, 2005; Noroozi et al., 2015). The HBM has been used to evaluate potential behavior changes associated with risk perceptions of tick-borne diseases, such as in Bayles (2013), Shadick et al., (1997), Aenishaenslin et al., (2016), Macauda (2007), and Corapi et al., (2007). Bayles (2013) found that

**Figure 1.4:** The Health Belief Model components. Image from Champion & Skinner (2008)
socioeconomic location was a key modifying factor in determining knowledge of tick-borne diseases, with rural residents showing more awareness of tick-borne diseases in general than urban inhabitants. Bayles surmised that this was because they spent more time recreating outdoors. However, the same study concluded that perceived severity of actually being infected by a tick was low across all location types. Donohoe et al., (2018), also found significant relationships between high perceived risk, the modifying factor of specific knowledge, and the adoption of preventive behaviors related to tick-borne diseases in park management workers. Aenishaenslin et al., (2016), evaluated the success of a tick-borne disease prevention campaign, finding that respondents in areas of lower entomological risk experienced increased awareness. However, pundits of the model have argued that its worthiness as a direct-use method is shaky and worth updating, with variance not always correlating at levels elevated enough to draw significant conclusions (Calnan, 1984; Carpenter, 2010; Yarbrough and Braden, 2001). Calnan (1984) deduced that the overall variance depicted in the study that could be related to the HBM model was small. Yarbrough and Braden (2001) found a similar conclusion that HBM could not explain a large percentage of the variance. It is important to note that both these studies referred to breast cancer screening behaviors. Carpenter (2010) conducted a meta-analysis to calculate the effectiveness of the HBM in predicting behavior and found that perceived barriers and benefits were the strongest predictors of behaviors, but still did not recommend the continuation of a direct-effects HBM model. To address these concerns and increase the effectiveness of the theoretical framework to predict potential behavioral shifts, I will incorporate constructs from the HBM and value statements derived from the zoonotic disease risk information seeking and processing (ZDRISP) in this study.
1.4.2. The Zoonotic Disease Risk Information and Processing Model

Zoonotic diseases are infectious diseases that are able to be transmitted from animal to human populations and vice-versa and are acknowledged as increasing threats to global human, animal, and environmental health as well as economic security (Allen et al., 2017; Wang and Crameri, 2014). These emerging and often neglected diseases have been attracting more attention in the greater health community thanks to recent events such as the Covid-19 pandemic. However, zoonotic diseases have been responsible for the majority of infectious outbreak events since the 1940s, with 72 percent of outbreaks originating in wildlife (Jones et al., 2008). The risk information seeking and processing (RISP) model (figure 5) characterizes how human individuals gather and evaluate knowledge about risk (Griffin, Dunwoody, and Neuwirth, 1999). Risk information seeking and risk information processing are viewed as variables dependent on one another in this model, which draws from earlier behavior models (Azjen, 1988; Chen, Duckworth, and Chaikin, 1999; Slovic, 1987). RISP has been used in a wide variety of fields in an attempt to hypothesize how and why individuals gather and store knowledge. Risk information-seeking refers to the methods from which individuals gather knowledge, such as mass media sources, governmental leadership, and word of mouth (Griffin, Dunwoody, and Neuwirth, 1999). Risk processing refers to how individuals actually perceive and react to the information sources. Figure 1.5 below illustrates constructs integral to the RISP model.

Perceived hazard characteristics are factors that influence judgment of risk, trust that the federal and or state managers can handle the hazard in question, and the individuals’ own confidence in their ability to adapt to and survive the risk (Clarke, 2009; Griffin, Dunwoody, and Neuwirth, 1999). These factors result in an affective response (worry) which then triggers the need for more information. Based on the perceived hazard characteristics, an individual may rely
on their current knowledge or believe that they have sufficient information about the risk. These are referred to as information subjective norms (Griffin, Dunwoody, and Neuwirth, 1999). The individual then participates in either information seeking or avoidance behaviors, based on their channel beliefs shaped by mass media, culture, and other societal pressures. If they then pursue an information-seeking behavior, their processing of said new knowledge will either be heuristic or systematic in nature. Heuristic processing is a form of self-learning which is more emotional based, whereas systematic processing is a multi-leveled approach where learners logically process information to either validate or invalidate its credibility (Chaiken, 1980; Clarke, 2009; Griffin, Dunwoody, and Neuwirth, 1999).

Rose, Toman, and Olsen (2017) used the RISP model to analyze what factors caused Wisconsin residents to access information about smoke emissions and health effects. Cross et al., (2018), used the RISP model to study information-seeking behaviors in Minnesota deer hunters to understand their reasoning for obtaining information related to Bovine tuberculosis. Their findings acknowledged that a large proportion of variability in these behaviors was attributable

Figure 1.5: Griffin, Dunwoody, and Neuwirth’s RISP model (1999)
to factors depicted in the RISP model. Research that has applied the RISP model, points to individuals who more eagerly gather and consume information tend to adapt to healthier behaviors (Clarke, 2009; Griffin, Dunwoody, and Neuwirth, 1999).

While RISP is an often-used basic theoretical framework for analyzing risk perceptions, some researchers have criticized its performance in applied research. Yang, Aloe, and Feeley (2014) conducted a meta-analysis on various studies utilizing the RISP model, finding that the model had limited success when explaining heuristic processing, or factors causing “low” attitudes in respondents. Aliperti and Cruz (2019) used the RISP model to assess similarities and differences in risk communication seeking behaviors between Chinese and American tourists regarding disaster information in Japan. They found that the model could benefit from additional individual characteristics recognized as factors such as behavioral differences between the two tourist groups in their acceptance of informational subjective norms and their capacity for heuristic vs. systematic processing. In order to amend the model to be more specific on a case by case basis, certain authors have recommended tailoring the approach more specifically to deal with zoonotic disease risk and management problems (Clarke, 2009; Triezenberg et al., 2014).

Clarke (2009) adapted the RISP model to zoonotic disease by exploring how concepts such as wildlife values, trust in management and leadership, and societal pressures influenced the ways that individuals sought out information related to a specific disease system. This new and improved ZDRISP model therefore is uniquely tailored to be applied to disease-management research and policies, and better suited to reach conclusions that will benefit future communication strategies and interventions. For our conceptual framework, we will focus on using the wildlife values, trust in management and leadership, and socio-cultural pressures in coordination with the Health Belief Model factors and beliefs.
1.4.3. Other Theoretical Elements

The ZDRISP model fits well into the principles dictated by the growing surge of “One Health” related research interests. The One Health principle can be addressed as a transdisciplinary and multi-dimensional collaboration between the medical, veterinary, environmental, and public health fields in order to facilitate commitment to greater ecosystem health, equitable social systems, and conflict reduction (FAO-OIE-WHO, 2010). According to the Centers to Disease Control, the approach works at the local, regional, national, and global levels (CDC, 2021). It is imperative to ensure that intervention methods involving risk communication be altered to not influence negative attitudes towards wildlife and nature (Buttke, Decker, and Wild, 2015; Decker et al., 2012; van Herten et al., 2018). Therefore, this study uses the added elements of wildlife values, trust in tick-borne disease information sources, and opinion of leadership in order to better evaluate risk perceptions (Clarke, 2009).

Research has shown that there are other factors that influence health behaviors and risk perceptions of disease. For example, Roh et al., (2015), found that political affiliation and temporal framing of an issue heavily influence perceptions of Lyme disease risk. Temporal framing refers to the period of time when an issue is pertinent, whether it be a current and “now” problem or an issue to be faced five, ten, twenty years down the line (Roh et al., 2015). To better understand perceived risks, we will also include political affiliation and temporal framing within our instrument questions. Temporal framing is directly related to the idea of psychological distancing. Psychological distancing is the act of being cognitively separate from society or an event (Trope and Liberman, 2003; Baltatescu, 2001). Typically, the term is used to describe the distancing from a person or an event of a stressful nature. Trope and Liberman (2003) combines the concept of psychological distancing with temporal framing through the construal level
theory, which maintains that separation of time changes the way an individual perceives the threat of a future event. This concept goes on to propose that individuals view further distances of time in an abstract, high-level manner, whereas events that are closer in time tend to elicit more concrete, low-level consequences—meaning that individuals are more likely to form stronger responses to distant future events (Trope and Liberman, 2003).

Our combined HBM/ZDRISP model for this study will include the modifying factors of age, gender, political affiliation, ethnicity, socioeconomic status, sociocultural pressures, pre-existing knowledge, wildlife values, and trust in management/leadership. This proposed framework is shown below in Figure 1.6. The resulting information will shed light on the relationship between risk perceptions and corresponding actions and better inform intervention strategies moving forward.

![Proposed theoretical framework](image)

**Figure 1.6**: Proposed theoretical framework. Adapted from Champion & Skinner (2008) and Clarke (2009)
1.5. Organization of the Thesis

Chapter two presents the results of the 2019 Acadia National Park mixed-mode visitor survey. Instrument questions revolved around recreational activities within the park, the understanding and knowledge of various tick-borne diseases, and questions regarding the use of prevention measures. This survey captured primarily out-of-state visitors. In particular, we were interested in how being from an area endemic to Lyme disease influences travel behavior and TBD knowledge. This chapter investigates statistical differences and/or similarities between two groups: visitors from areas endemic for Lyme disease and other TBDs and visitors from non-endemic TBD areas.

The survey depicted in Chapter three, on the other hand, was created strictly for Maine resident recreationists. This survey instrument consisted of questions regarding knowledge of tick-borne diseases, preventive measures, general outdoor recreation activities, and demographic information, as well as questions concerning trust in informational sources and values. Chi-square analyses were used to investigate if differences in knowledge, barriers to uptake of protective measures, and preventive behavior usage exist amongst resident outdoor recreationists based on political affiliation.

The fourth chapter consists of a comparative analysis of the previous two surveys involving perceptions of resident and non-resident outdoor recreationists in Maine. Chi-square analysis was the primary statistical test used to compare across groups. Risk perceptions, knowledge, protective measure usage, and perceived efficacy of preventive behaviors were all investigated and reported on. Finally, the last chapter presents conclusions drawn from this research and introduces potential next steps, as well as discusses communication outputs related to the research.


and processing (RISP) model for wildlife disease management. *Frontiers in Veterinary Science, 5*, 190.


CHAPTER 2
RISK PERCEPTIONS OF TICK-BORNE DISEASES IN ACADIA NATIONAL PARK VISITORS

2.1. Abstract

Acadia National Park, in coastal Maine, is a top nature-based tourism destination in the United States, which serves as an important economic contributor to the state as a whole. Rates of tick-borne disease infections have been rising in Maine since the early 90s, as have visitation rates to Acadia National Park. The mild to warm summer climate and densely forested landscape of the park make it a uniquely suitable habitat for blacklegged-ticks, the vector for tick-borne diseases like Lyme disease. Therefore, it is important to understand how visitors perceive their risk for tick-borne disease and the measures that they undertake to reduce their exposure to disease risk. A mixed-mode visitor survey was conducted in Acadia National Park, consisting of a five-minute intercept interview followed by a longer, online-based self-administered survey instrument. A total of 624 respondents completed the online questionnaire. Respondents were classified into two groups: those from areas endemic for Lyme disease and those from areas where Lyme disease has not historically been a concern. Results showed differences in tick-check behaviors, factual tick knowledge, and perceived risk of tick-borne disease amongst these groups. Results also revealed significant differences in belief that climate change and an overabundance of white-tailed deer play a role in increased tick presence in Maine. These results imply that endemicity of home location may be a predisposing factor of Acadia National Park visitor risk perceptions and may warrant different management strategies per visitor group.
2.2. Introduction

Infectious diseases are a growing area of concern globally. In Maine, tick-borne diseases have steadily been on the rise since the early 90s (Rand et al., 2007; Robert et al., 2019; Smith et al., 2019). Lyme disease, in particular, is a virulent issue in much of the northeastern United States. In 2019 alone, there were over 2,000 confirmed cases of Lyme disease in Maine, the largest ever case amount for the state on record (Maine CDC, 2020). Because of underreporting, it is likely that the actual case amount was much higher. Lyme disease is transmitted through the bite of its primary--but not only--vector, the black-legged tick (Ixodes scapularis, Say 1821). The disease itself is caused by the bacteria Borrelia burgdorferi (Burdorfer et al., 1982).

The two-year life cycle of the black-legged tick uniquely correlates with Maine’s summer tourism season, with most human infections occurring during the months of June to October (Hamer et al., 2012). Recent data from the Maine Centers for Disease Control show yearly spikes of Lyme diagnoses occurring from April to August, and again from August to September (Maine CDC, 2020). The number of visitors to Acadia National Park in 2019 averaged about 445,000 visitors per month from May-October each, compared with a monthly average of 23,000 visitors from November-April (National Park Visitor Use Statistics, 2019). Nymph activity is highest during the late spring and summer season, roughly occurring from May to August (Bouchard et al., 2011; Hamer et al., 2012). Adult ticks primarily feed during the late summer and autumn (Piesman et al., 2002).

The combination of outdoor activities and a summer tourism season that correlates with increase tick presence and questing at places with reported tick-borne diseases, like Acadia National Park (ANP), may increase the exposure of large numbers of tourists to tick-borne disease risk (Daltroy et al., 2007). Acadia, and other national parks, often present elevated
susceptibility levels to tick-borne diseases, as well as other zoonoses, mostly due to visitors being in natural settings (Jones et al., 2015; Eisen et al., 2013). National parks are known as areas with heightened entomological risk. Entomological risk is determined by areas with higher than normal abundance of vectors, in this case, blacklegged ticks and other northeastern thriving tick species (Piacentino and Schwartz, 2002; Donohue et al., 2015; Fischhoff et al., 2019). These risks may be heightened if visitors are unfamiliar with prevention measures, or who are from areas where TBD’s are not endemic or widely occurring (Han et al., 2009; Jones et al., 2015).

2.2.1. Tourism in Acadia National Park

ANP is the only national park in the Northeastern U.S. The park is located in the Downeast region of Maine (Figure 2.1), mostly on Mount Desert Island-including some small neighboring coastal islands- and partially extends to mainland Maine via the Schoodic Peninsula. The park is just over 49,000 acres, with a sizable portion of the region featuring granite peaks and both deciduous and coniferous woodlands (Maine Natural Areas Program, 2013).

![Figure 2.1: Map of Acadia National Park in relation to Downeast Maine. Image from National Park Service.](image-url)
ANP receives its highest number of visitors annually during the calendar months of July-October, with overall visitation for 2019 numbering 3,437,286 visitors (National Park Visitor Use Statistics, 2019). In 2018 alone, the park generated nearly $388 million in economic revenue for the state (National Park Service, 2018). Given the growing trend in visitor numbers to Acadia there is an increased concern with the public health implications and the need to create visitor management strategies to reduce risk of exposure to ticks and tick-borne disease. The purpose of this study is to identify risk perceptions and prevention behaviors of visitors to Acadia National Park regarding ticks and tick-borne diseases.

ANP is the 7th most visited park within the United States (National Park Visitor Use Statistics, 2019) and is located in an area endemic for Lyme and other tick-borne diseases. Since outdoor recreation is the primary activity category within the park, the high visitation numbers mean that millions of visitors are potentially at risk for tick-borne diseases. Furthermore, a 2016 survey identified that increased vector-borne disease risk could influence future visitation rates and have public health and economic consequences (De Urioste-Stone et al., 2016).

The inclusion of mixed forest habitat and the influx of visitors during the summer and fall tick season make the park an important region for tick-borne disease concern and research, especially considering the interest of visitors to engage in outdoor activities during their travel to the area. In terms of outdoor recreation, Soucy & De Urioste-Stone (2020) found that park-goers could be split into two primary recreation groups consisting of nature-based activity “adventurists” and less nature-motivated visitors or “sightseers”.

ANP was chosen as the study site because of its popularity as a nature-based recreation destination with millions of people visiting the park every year, and because of the high rates of Lyme Disease incidence within Hancock County, where the park is located. Robert et al (2019)
found that Hancock county had the second highest-record of average infection incidence in Maine, only behind neighboring Knox county. Furthermore, because of its popularity among in-state and out-of-state visitors, Acadia is the ideal study location for performing surveys and locating respondents.

2.2.2. Conceptual Foundation

Lowering the burden of tick-borne diseases is of utmost concern nationwide, and a focus on preventive behaviors such as personal-protective measures is becoming more common in research (Peisman and Eisman, 2008). However, recent studies have identified barriers to practicing preventive measures regarding diseases including knowledge of diseases, risk perceptions, and demographics. Barriers refer to hurdles encountered by respondents that may minimize their ability to use preventive measures. Bosch et al., (2010), found that workplace culture was a potential barrier to the adoption of personal protective measures in the National Park System, with employees less likely to use personal protective equipment (PPE) if their immediate colleagues were not. Eisen and Stafford (2020) conducted a review pertaining to the literature regarding barriers to effective tick-bite prevention and found that effectiveness of measures, cost of new clothing and protective equipment, and limited understanding of acaricides and insecticides all affected uptake of protective measures. Our study utilized some of these barriers including cost of purchasing new items and doubts regarding efficacy of measures.

Efficacy is the level of success associated with a protective measure, or how useful a preventive behavior such as performing a tick-check actually is. Efficacy can be actual or perceived (Butler et al., 2016; Donohue et al., 2018). Self-efficacy, on the other hand, refers to an individual’s belief that they can control their own risk (Champion and Skinner, 2008; Beaujean et al., 2013). Protective measures refer to actions that can be partaken to reduce risk.
Examples of protective measures to combat tick bites include performing tick checks (Vasquez et al., 2008; Bayles, 2013), wearing insect repellent and using acaricides (Miller et al., 2011), utilizing long-sleeved clothing and tucking pants into socks (Hayes and Piesman, 2003; Miller et al., 2011).

Risk perceptions are subjective judgments of the perceived severity of negative occurrences or hazards (Slovic et al., 1980). Successful health interventions utilize knowledge about risk perceptions to change behaviors (Ferrer and Klein, 2015). Risk perceptions have been applied to various fields of research, including climate change (van der Linden, 2015), media amplification of climate adaptation risk (Chapman, 2016), health behavior (Ferrer and Klein, 2015), and wildlife conservation (Buttke, Decker, and Wild, 2015; Decker et al., 2012; Hanisch-Kirkbride, Riley, and Gore, 2013; Lu et al., 2017). Risk perceptions have also been strongly utilized in health risk research (Brewer et al., 2004; Herrington, 2004; Beaujean et al., 2013; Aenishaenslin et al., 2014).

Typically, there are two main components of most risk-perception models: cognitive and emotional processing (Feigenson, Bailis, and Klein, 2004; Freimuth and Hovick, 2012; Leppin and Aro, 2009; Paek and Hove, 2017). Cognitive factors related to risk perceptions involve how individuals obtain knowledge and understand risk, whereas emotional factors cover how individuals feel about these risks and their severities. Cognition and accumulation of knowledge have been linked to lower tick-borne disease risk, as well as coinciding with motivations to pursue disease prevention measures (Piacentino and Schwartz, 2002; Herrington, 2004; Donohue et al., 2015).

Socio-cultural factors also play a role in risk perceptions, and these factors include value orientations, political affiliations, and societal norms (Decker et al., 2012; van der Linden, 2015).
Risk perceptions have also been found to be influenced by media coverage of a threat (Hove and Paek, 2015; Hove and Paek, 2017). Decker et al., (2012) found a correlation between types of communication (i.e., emotion vs. logic) regarding zoonotic diseases and how particularly emotional reasoning motivated respondents towards exaggerated, fear-based responses. Similarly, Ferrer and Klein (2015) proposed that deliberative, active messaging was most successful in promoting the adoption of general health behaviors, while Bayles (2013) found that rural respondents were more likely to be aware of tick-borne diseases rather than urban residents.

Understanding the cognitive and emotional factors behind risk perceptions is integral to creating a more complete picture as to why certain groups may have diverse levels of risk perceptions, and practice different behaviors towards tick-borne disease exposure. Similarly, seeing which socio-psychological-cultural factors most influence perceptions is useful in determining future communication strategies related to modifying health behaviors.

Areas endemic for tick-borne diseases such as Maine and then northeastern United States contain higher amounts of disease vectors, therefore increasing entomological risk (Han et al., 2009; Jones et al., 2015; Fischhoff et al., 2019). Endemity refers to whether or not a region is endemic for a certain vector or group of diseases (Aenishaenslin et al., 2014; Slunge and Boman, 2018; Bouchard et al., 2018). Examining place of residence of visitors to a natural resource area based on endemity for tick-borne disease may help understand potential differences in risk perceptions amongst national park users (Hook et al., 2015; Fischhoff et al., 2019). The Centers for Disease Control categorizes endemity for vector-borne diseases as two groups; endemic regions are labeled high incidence areas, whereas non-endemic regions are referred to as low incidence areas (Centers for Disease Control, 2018).
This study aims to determine whether endemicity does influence risk perceptions related to tick-borne diseases (especially Lyme disease) and preventive behavior. Acadia National Park is a well-traveled location that receives visitors of varying demographics, and using endemicity to examine the drivers of risk perception and barriers to adopting protective behaviors could be a potentially useful tool to implement in future research. Our study examines hypotheses: (1) Visitors to ANP hailing from regions endemic to Lyme disease (high incidence states) will have overall higher rates of knowledge, perceived risk, and usage of protective behaviors than visitors from non-endemic regions; and (2) Non-endemic and endemic groups will not show significant differences in barriers to uptake of behaviors.

2.3. Methods

2.3.1. Survey Design and Visitor Sampling

A mixed-mode visitor survey (Dillman et al., 2014) was conducted from May 2019 to October 2019. Undergraduate and graduate students interviewed visitors on-site using a 5-minute intercept survey instrument in Qualtrics that collected demographic and travel data. Once a visitor completed the in-person component, they were provided a postcard with a link and personal code to complete a more comprehensive self-administered online survey instrument (Dillman et al., 2014) using Qualtrics. To increase the response rate, participants could enter a raffle drawing upon completion of the online questionnaire. Participants were sent up to three email reminders to take the online survey (Dillman et al., 2014).

We used a two stage-cluster probability sampling design to select potential survey participants (Scheaffer, Mendenhall III, Ott, & Gerow, 2012). First we randomly selected 23 dates/times to conduct the on-site survey (De Urioste-Stone et al., 2016). Once on-site, we used a
systematic probability sampling strategy whereby researchers selected every 2nd or 3rd visitor group depending on how busy the day was (Wilkins, De Urioste-Stone, Weiskittel, and Gabe, 2018), and asked the person with the most recent birthday to participate (Dillman et al., 2014). Surveying took place at seven sampling sites within Acadia National Park including Sand Beach, Hulls Cove Visitor Center, Cadillac Mountain, the Shore Path, Jordan Pond, Sieur de Monts, and Thunder Hole. These locations were chosen because of their high visitation rates. The team conducted a total of 1907 intercept surveys and obtained 624 follow-up survey responses (response rate of 32.6%). After data cleaning, one respondent was removed for being underage and four more were removed for not answering any questions on the online instrument (N=619). Non-response bias was tested using Pearson’s chi-square test of independence to compare intercept survey participants (N=1907) with follow-up survey respondents (N=619) (Catania et al., 1986). There was no statistical differences in first time visitation ($x^2=.212$, 1 df, $p=.645$), knowing what ticks are ($x^2=.086$, 2 df, $p=.958$), and concerns about TBDs causing respondents to stop recreating outdoors ($x^2=4$ df, $p=.258$).

The online questionnaire included four sections to assess (1) travel behavior, (2) risk perceptions and preventive behaviors practiced by respondents, (3) barriers and motivations to engaging in preventive behaviors, and (4) socio-demographics. We used previously tested measures from a 2018 visitor survey conducted at ANP (Soucy & De Urioste-Stone, 2020).

2.3.2. Variables and Measures

Travel Behavior

Respondents were asked if they had visited Acadia previously (0: no, 1: yes). Using previously tested measures (Soucy & De Urioste-Stone, 2020) visitors were asked “Which trails did you and your personal group visit at ANP?” and “What was your primary recreational
activity at ANP?”. The answer options for this section’s questions were presented in multiple-choice or select-all-that apply format.

Knowledge

Participants were asked questions regarding facts about ticks (true/false), existing tick-borne diseases in Maine (true/false), general facts about Lyme disease (true/false), and tick habitats (scale from 1: very likely, 5: not very likely). The tick and habitat knowledge questions were compiled into a total fact score (0= low knowledge, 15= high knowledge). In order to be scored for factual tick knowledge, respondents had to answer at least four of the six true false questions and all of the tick habitat questions.

Perceived Risk

Respondents were asked a range of questions to rate their opinions on tick risk using a 7-point Likert scale (-3=strongly disagree, 3=strongly agree). They were also asked questions regarding their potential for changing behaviors out of concern for tick-borne diseases (-3=strongly disagree, 3:=strongly agree). These scores were compiled to create a perceived risk score (-10= very low perceived risk, 30= high perceived risk). Perceived risk is a respondent’s acknowledgment of dangers associated with certain actions (Rimal and Real, 2003; Waters et al., 2014).

Respondents were also asked whether they believed that certain factors influenced increased tick presence in Maine on a 7-point Likert scale where -3= strongly disagree with the reason and 3= strongly agree. The data were then recoded into three categories used for final analysis, where 1= agree, 0= neutral, and -1= disagree.
Protective Measures, Barriers, and Efficacy

Participants were asked to rank how often they performed tick checks, wore long-sleeved clothing, used insect repellent, and tucked pants into socks (0= never, 1= sometimes, 2= always). These scores were gathered into a total preventive behavior score (0= no behavior use, 8= high behavior use). Participants were then asked questions regarding barriers to adopting certain preventive measures and their motivations for using those behaviors on a 7-point Likert scale where (-3= strongly disagree, 3= strongly agree). Barriers used included “long-sleeved clothing being too warm”, “cost of clothing is too high”, among others. Respondents were asked to measure how effective certain preventive measures were (-3= not effective at all, 3= extremely effective).

Sociodemographics and Place of Origin

The last section of the survey instrument included questions related to socio-demographic factors such as age (open response), gender (1=male, 2= female), political affiliation (1=liberal, 2=conservative, 3=independent), and education (1=lower education, 2=higher education). One question asked respondents to fill in their respective zip codes. To determine whether or not a region was prone to tick-borne diseases, each zip code was compared with the Centers for Disease Control most recent 2018 map representing risk areas for Lyme disease. The total respondents who responded to the zip code question (N=398) were grouped into participants from regions endemic for Lyme disease and those from regions not endemic for Lyme (Table 2.1). States listed on the CDC map as “high incidence” Lyme areas were therefore labeled endemic, and “low incidence” areas were labeled non-endemic (Centers for Disease Control, 2018). Within this system, all states in the northeastern United States, from Maine down to Virginia, are considered endemic, as are the midwestern states of Minnesota and Wisconsin.
Table 2.1: Breakdown of endemic area groups derived from the Centers for Disease Control (2018)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitors from areas endemic for Lyme disease (high incidence areas)</td>
<td>Residents of Maine, New Hampshire, Massachusetts, Vermont, Connecticut, New York, New Jersey, Pennsylvania, Washington D.C., Delaware, Maryland, West Virginia, Virginia, Minnesota, and Wisconsin</td>
<td>261 (42%)</td>
</tr>
<tr>
<td>Visitors from areas not endemic for Lyme disease (low incidence areas)</td>
<td>Residents from all other states including Alaska and Hawaii</td>
<td>137 (22%)</td>
</tr>
</tbody>
</table>

2.4. Data Analysis

After grouping respondents into endemic and non-endemic regions, chi-square tests were run to investigate if differences existed between the groups in terms of level of education, gender, political leanings, travel behavior, and use of tick-borne disease preventive behaviors (i.e., tick checks, wearing long-sleeved clothing, using insect repellent, and tucking pants into socks. The Pearson chi-square and Cramer’s V were reported for effect size (Sun et al., 2010; Tomczak and Tomczak, 2014).

Independent samples t-tests examined for endemicty group differences in terms of factual tick knowledge, perceived risk, and usage of preventive behaviors. Levene’s statistic tested the assumption of variances between groups, with the hypothesis being that respondents from the endemic group would have higher rates of knowledge, risk, and behavior usage. If Levene’s was violated, the equal variances not assumed measure was reported (Brown and Forsythe, 1974). Cohen’s d was reported to assess independent sample effect size (Cohen, 1988).

All tests were conducted using SPSS v. 27.
2.5. Results

2.5.1. Results by Endemicity

As depicted in Table 2.2, the majority of the total respondents were first-time visitors to Acadia National Park (56%). The gender group consisted of mostly females (44%) with slightly fewer males (31%). The largest education group was those with a higher degree of education (61%). Political leanings were skewed more towards liberals (30%) and independents of both conservative and liberal leanings (29%). Conservatives made up the smallest political group (14%).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Endemic locations</th>
<th>Non-endemic locations</th>
<th>Chi-square (sig)</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher education</td>
<td>N=261</td>
<td>N=137</td>
<td>.450 (.503)</td>
<td>.034</td>
</tr>
<tr>
<td>Lower education</td>
<td>210</td>
<td>114</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No response</td>
<td>51</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>N=261</td>
<td>N=137</td>
<td>2.31 (.32)</td>
<td>.076</td>
</tr>
<tr>
<td>Female</td>
<td>96</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No response</td>
<td>164</td>
<td>77</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Political leanings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td>N=255</td>
<td>N=131</td>
<td>14.90 (.001)</td>
<td>.196</td>
</tr>
<tr>
<td>Independent</td>
<td>36</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liberal</td>
<td>104</td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No response</td>
<td>115</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Visitation status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First-time visitors</td>
<td>N=259</td>
<td>N=137</td>
<td>59.22 (.000)</td>
<td>.387</td>
</tr>
<tr>
<td>Multiple visits</td>
<td>105</td>
<td>111</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>154</td>
<td>26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As seen in Table 2.2, there was no significant differences in education ($\chi^2(1, N=261)=.450, p=.503$) or gender ($\chi^2(2, N=398)=2.31, p=.32$) between endemicity groups. There was, however, a statistically significant difference in political leanings ($\chi^2(2, N=386)=14.90, p=.001$), with visitors from endemic regions leaning more towards liberal tendencies than those from non-endemic areas. Visitation status also elicited a significant difference between groups ($\chi^2(1, N=396)=59.22, p=.000$). First-time visitors mostly belonged to the non-endemic group of respondents, versus repeat visitors, who were mostly from regions endemic for Lyme and other tick-borne diseases.

In Table 2.3, chi-square analysis of preventive measures revealed a significant difference between tick-check usage amongst the two groups ($\chi^2(2, N=398)=6.13, p=.047$). Visitors from endemic areas reported utilizing tick-checks at higher rates than visitors from non-endemic areas. There were no significance differences across endemicity groups for the insect repellent, long-sleeved clothing, and tucking pants behavior; however, it was interesting that 42.5% of respondents from regions endemic for Lyme reported never tucking their pants into socks and 47.5% of this same group cited they only sometimes tucked in their pants. Similarly, 47.4% of respondents from regions not endemic for Lyme responded that they never used this behavior, and 47.4% of this group only used it sometimes. Based on these percentages, tucking pants into socks was by far the least popular choice of preventive measure among the respondents in this survey.
Table 2.3: Chi-square results of protective measures by endemcity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total respondents (percent)</th>
<th>Endemic locations (percent)</th>
<th>Non-endemic locations (percent)</th>
<th>Chi-square (sig)</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing tick checks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>34 (5.5%)</td>
<td>11 (4.2%)</td>
<td>12 (8.8%)</td>
<td>6.13 (.047)</td>
<td>.124</td>
</tr>
<tr>
<td>Sometimes</td>
<td>342 (55.3%)</td>
<td>150 (57.5%)</td>
<td>86 (62.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>197 (31.8%)</td>
<td>100 (38.3%)</td>
<td>39 (28.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing insect repellent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>55 (8.9%)</td>
<td>26 (10%)</td>
<td>14 (10.3%)</td>
<td>1.34 (.51)</td>
<td>.510</td>
</tr>
<tr>
<td>Sometimes</td>
<td>423 (68.3%)</td>
<td>193 (73.9%)</td>
<td>106 (77.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>93 (15%)</td>
<td>42 (16.1%)</td>
<td>16 (11.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing long sleeved clothing</td>
<td></td>
<td></td>
<td></td>
<td>.467 (.80)</td>
<td>.034</td>
</tr>
<tr>
<td>Never</td>
<td>27 (4.4%)</td>
<td>11 (4.2%)</td>
<td>4 (2.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>445 (71.9%)</td>
<td>208 (80%)</td>
<td>110 (80.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>100 (16.2%)</td>
<td>41 (15.8%)</td>
<td>23 (16.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tucking pants into socks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>253 (40.9%)</td>
<td>111 (42.5%)</td>
<td>65 (47.4%)</td>
<td>3.04 (.22)</td>
<td>.087</td>
</tr>
<tr>
<td>Sometimes</td>
<td>261 (42.2%)</td>
<td>124 (47.5%)</td>
<td>65 (47.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>59 (9.5%)</td>
<td>26 (10%)</td>
<td>7 (5.1%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Independent samples t-tests revealed that there were statistically significant differences in how respondents from endemic locations perceived tick-borne disease risk in comparison to those from non-endemic areas (t(383)= 3.20, p= .002), as seen in Table 2.4 below. Visitors from non-endemic areas reported lower perceived risk scores than those from endemic regions. Results of the factual tick knowledge questions also yielded significant differences between groups (t (266) = 1.99, p=.05), with visitors from endemic regions reporting higher tick-fact
knowledge than those from non-endemic areas. No significant differences were reported for total usage of preventive behaviors between the two groups.

**Table 2.4:** Comparison of knowledge, perceived risk, and usage of preventive behaviors broken down by group (reported as mean values)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total respondents mean (N)</th>
<th>Endemic locations mean (N)</th>
<th>Non-endemic locations mean (N)</th>
<th>Levene’s statistic (sig)</th>
<th>T-test (sig)</th>
<th>Cohen’s D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factual tick questions</td>
<td>12.11 (266)</td>
<td>12.22 (177)</td>
<td>12.00 (89)</td>
<td>.007 (.93)</td>
<td>1.99 (.05)</td>
<td>.95</td>
</tr>
<tr>
<td>Perceived risk</td>
<td>12.90 (385)</td>
<td>13.70 (252)</td>
<td>11.21 (133)</td>
<td>.03 (.86)</td>
<td>3.20 (.002)</td>
<td>.340</td>
</tr>
<tr>
<td>Usage of protective measures score</td>
<td>4.14 (570)</td>
<td>4.19 (260)</td>
<td>3.93 (136)</td>
<td>2.83 (.093)</td>
<td>1.69 (.091)</td>
<td>.162</td>
</tr>
</tbody>
</table>

Respondents were asked whether they believed that certain factors influenced increased tick presence in Maine on a 7-point Likert scale where -3= strongly disagree with the reason and 3= strongly agree. Results of the chi-square analysis depicted in Table 2.5 below shows that tick habitat, human development, and increased rodent presence were not significantly different between respondents from endemic locations versus those from non-endemic locales. However, climate change was significantly different between groups ($\chi^2(6, N=379) = 13.58, p=.001$), with visitors from endemic regions agreeing that climate change was a reason behind increased tick presence. The belief that overabundant white-tailed deer influenced tick increases also was significantly different between groups ($\chi^2(6, N=378) = 7.946, p=.019$), with visitors from endemic regions more likely to believe that white-tailed deer could be a cause for increased tick presence.
Table 2.5: Chi-square comparison of reasons for increased tick presence in Maine by endemicity group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total respondents (%)</th>
<th>Endemic locations (%)</th>
<th>Non-endemic locations (%)</th>
<th>Chi-square (sig)</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available tick habitat</td>
<td>N=430</td>
<td>N=244</td>
<td>N=129</td>
<td>.077 (.96)</td>
<td>.014</td>
</tr>
<tr>
<td>Agree</td>
<td>282 (65.6%)</td>
<td>160 (65.6%)</td>
<td>83 (64.3%)</td>
<td>.077 (.96)</td>
<td>.014</td>
</tr>
<tr>
<td>Neutral</td>
<td>91 (21.2%)</td>
<td>54 (22.1%)</td>
<td>29 (22.5%)</td>
<td>.077 (.96)</td>
<td>.014</td>
</tr>
<tr>
<td>Disagree</td>
<td>57 (13.3%)</td>
<td>30 (12.3%)</td>
<td>17 (13.2%)</td>
<td>.077 (.96)</td>
<td>.014</td>
</tr>
<tr>
<td>Climate change</td>
<td>N=436</td>
<td>N=248</td>
<td>N=131</td>
<td>13.58 (.001)</td>
<td>.189</td>
</tr>
<tr>
<td>Agree</td>
<td>268 (61.5%)</td>
<td>169 (68.1%)</td>
<td>64 (48.9%)</td>
<td>13.58 (.001)</td>
<td>.189</td>
</tr>
<tr>
<td>Neutral</td>
<td>113 (25.9%)</td>
<td>55 (22.2%)</td>
<td>45 (34.4%)</td>
<td>13.58 (.001)</td>
<td>.189</td>
</tr>
<tr>
<td>Disagree</td>
<td>55 (12.6%)</td>
<td>24 (9.7%)</td>
<td>22 (16.8%)</td>
<td>13.58 (.001)</td>
<td>.189</td>
</tr>
<tr>
<td>Human development</td>
<td>N=430</td>
<td>N=244</td>
<td>N=128</td>
<td>3.43 (.180)</td>
<td>.096</td>
</tr>
<tr>
<td>Agree</td>
<td>243 (56.5%)</td>
<td>145 (59.4%)</td>
<td>64 (50%)</td>
<td>3.43 (.180)</td>
<td>.096</td>
</tr>
<tr>
<td>Neutral</td>
<td>126 (29.3%)</td>
<td>68 (27.9%)</td>
<td>41 (32%)</td>
<td>3.43 (.180)</td>
<td>.096</td>
</tr>
<tr>
<td>Disagree</td>
<td>61 (14.2%)</td>
<td>31 (12.7%)</td>
<td>23 (18%)</td>
<td>3.43 (.180)</td>
<td>.096</td>
</tr>
<tr>
<td>Increased rodent presence</td>
<td>N=434</td>
<td>N=246</td>
<td>N=131</td>
<td>5.85 (.054)</td>
<td>.125</td>
</tr>
<tr>
<td>Agree</td>
<td>266 (61.3%)</td>
<td>166 (67.5%)</td>
<td>72 (55%)</td>
<td>5.85 (.054)</td>
<td>.125</td>
</tr>
<tr>
<td>Neutral</td>
<td>130 (30.0%)</td>
<td>64 (26%)</td>
<td>46 (35.1%)</td>
<td>5.85 (.054)</td>
<td>.125</td>
</tr>
<tr>
<td>Disagree</td>
<td>38 (8.8%)</td>
<td>16 (6.5%)</td>
<td>13 (9.9%)</td>
<td>5.85 (.054)</td>
<td>.125</td>
</tr>
<tr>
<td>Overabundant white-tailed deer</td>
<td>N=435</td>
<td>N=250</td>
<td>N=128</td>
<td>7.95 (.019)</td>
<td>.145</td>
</tr>
<tr>
<td>Agree</td>
<td>315 (72.4%)</td>
<td>199 (79.6%)</td>
<td>85 (66.4%)</td>
<td>7.95 (.019)</td>
<td>.145</td>
</tr>
<tr>
<td>Neutral</td>
<td>89 (20.5%)</td>
<td>39 (15.6%)</td>
<td>32 (25%)</td>
<td>7.95 (.019)</td>
<td>.145</td>
</tr>
<tr>
<td>Disagree</td>
<td>31 (7.1%)</td>
<td>12 (4.8%)</td>
<td>11 (8.6%)</td>
<td>7.95 (.019)</td>
<td>.145</td>
</tr>
</tbody>
</table>

2.5.2. Results by Gender

A comparison of preventive behaviors broken down by gender group revealed no significant differences between performing tick checks ($\chi^2(4, N=465) = 1.480, p= .830$) between
male and female respondents. Conversely, there was a significant difference between how gender groups used the preventive behavior of tucking pants into socks ($\chi^2(4, N=465) = 16.91, p=.002$), with 55% of males reporting that they never tuck pants into socks, versus 52.7% of female respondents citing that they sometimes utilize this behavior (Table 2.6).

Table 2.6: Chi-square comparison of preventive behaviors by gender group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Gender (male)</th>
<th>Gender (female)</th>
<th>Chi-square (sig)</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing tick checks</td>
<td>N=191</td>
<td>N=273</td>
<td>1.480 (.830)</td>
<td>.040</td>
</tr>
<tr>
<td>Never</td>
<td>14 (7.3%)</td>
<td>15 (5.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>112 (58.6%)</td>
<td>159 (58.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>65 (34%)</td>
<td>99 (36.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing insect repellent</td>
<td>N=190</td>
<td>N=273</td>
<td>4.05 (.400)</td>
<td>.093</td>
</tr>
<tr>
<td>Never</td>
<td>22 (11.6%)</td>
<td>26 (9.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>146 (76.8%)</td>
<td>198 (72.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>22 (11.6%)</td>
<td>49 (17.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing long-sleeved clothing</td>
<td>N=191</td>
<td>N=272</td>
<td>.670 (.955)</td>
<td>.027</td>
</tr>
<tr>
<td>Never</td>
<td>7 (3.7%)</td>
<td>13 (4.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>151 (79.1%)</td>
<td>215 (79%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>17 (8.9%)</td>
<td>44 (16.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tucking pants into socks</td>
<td>N=191</td>
<td>N=273</td>
<td>16.91 (.002)</td>
<td>.135</td>
</tr>
<tr>
<td>Never</td>
<td>105 (55%)</td>
<td>100 (36.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>69 (36.1%)</td>
<td>144 (52.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>17 (8.9%)</td>
<td>29 (10.6%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.6. Discussion

The rate of tick-borne disease is increasing nationwide, even though exposure to these illnesses are largely controllable through the uptake of preventive behaviors. Understanding why different groups choose or choose not to utilize preventive behaviors is necessary to creating a
better overall understanding of exposure risk. Similarly, finding connections between knowledge and risk perception in varying demographics could help facilitate stronger and more targeted communication campaigns related to public health and tick-borne disease exposure risk. The hypotheses that residing in an area endemic for Lyme disease influenced various factors related to risk perception, knowledge, and preventive behaviors yielded mixed results. On one hand, variables such as the total usage of preventive behavior score and individually performing certain preventive behaviors, such as wearing long-sleeved clothing and using insecticides, were not statistically significant among the two groups. Perceived risk did vary significantly between respondent groups, with park-goers coming from areas endemic for Lyme and other tick-borne diseases tending to have higher perceptions of risk. Even with higher perceived risk, respondents from areas endemic for Lyme only engaged in tick check behavior more often rather than utilizing the full scope of suggested protective behaviors. Past studies have also seen low uptake of preventive behaviors even with higher awareness and perceived risk, so these results are not abnormal (Aenishaenslin, 2017). Butler et al (2015) found that tick checks were the most commonly used preventive behavior in an area endemic for Lyme disease, whereas using insect repellent was the least common behavior. Omodior et al (2015) also found that tick checks were the most commonly used behavior in their survey. Factual tick knowledge was higher for visitors from regions endemic for Lyme, justifying past research that links cognitive factors such as knowledge with exposure to tick-prone areas (Fischhoff, 2019).

Similar to findings from other studies, our research showed that visitors to Acadia National Park were less likely to use preventive behaviors such as using insect repellent and tucking pants into socks, with some differences in usage among both groups. Tick checks were the most popular form of preventive measure among both groups, but visitors from endemic
areas still performed tick checks significantly more often. Similarly, most respondents did not report tucking pants into socks, with nearly 50% of both groups answering that they never utilize that preventive measure. In a nationwide survey, Hook et al. (2015) reported that over fifty percent of respondents reported performing no preventive behaviors at all while engaged in warm weather recreational activities, even though respondents were generally aware of Lyme disease-related knowledge. Further studies are necessary to investigate whether communication campaigns and strategies tailored to different respondent groups can manage varying risk perceptions. Communication experiments, can be utilized to test potential response outcomes in different groups (Lu et al., 2017).

Respondents generally agreed that greater tick-habitat, human fragmentation, and more rodents influence the increased presence of ticks. However, there were discrepancies between groups when it came to climate change and blaming white-tailed deer. Butler (2016) found that the majority of participants surveyed in southwestern Connecticut, an area endemic for Lyme disease, acknowledged that ticks received blood meals from white-tailed deer and rodents. Gould et al., (2008), included a question asking about respondents’ feelings towards reducing white-tailed deer in a survey of Connecticut residents and their Lyme disease perceptions and found that 65 percent of respondents supported decreasing the deer population. Still, there is not a plethora of literature explaining discrepancies in respondents’ beliefs regarding the relationship between ticks and white-tailed deer. Participants from endemic areas were more likely to agree that climate change is a major factor supporting increasing numbers of ticks, whereas non-endemic respondents were more neutral towards this reasoning. The results of this study show that residing in areas with more tick-borne diseases may influence certain behaviors such as tick-check usage, level of knowledge about ticks, and risk perceptions of disease.
It is worth noting that tick-borne diseases and other zoonoses are prevalent in areas outside of the eastern United States and northern midwest. Bayles et al., (2013), used an urban to rural landscape gradient to evaluate knowledge of tick-borne diseases in Missouri, finding that non-urban respondents (exurban) generally performed more preventive behaviors. Donohue et al., (2018), evaluated occupational risks related to TBDs in Florida Fish and Wildlife employees, finding that higher rates of knowledge and higher perceived risk were significant predictors of utilizing tick checks. Herrington et al., (1997), investigated predispositions for Lyme disease prevention in respondents from the northeast and mountain west United States and showed similar results. Still, using endemicity as a tool to explore differences across groups based on area of residence could be useful in future studies evaluating risk perceptions of zoonotic disease in national park visitors nationwide.

Future research could provide inquiry into whether tailoring knowledge separately for high incidence and low incidence visitors actually results in better uptake of protective measures and higher knowledge values. Additionally, it may be worth expanding research related to Lyme and other tick-borne diseases in Maine to understand the perceptions of specific recreationists such as hunters and anglers, whom regularly recreate in high-exposure areas and may have differing views towards ticks, rodents, and white-tailed deer in comparison with tourists to national park areas. Other studies should be geared towards the evaluation of communication strategies regarding ticks and tick-borne diseases within the state of Maine and in other areas endemic for tick-borne diseases. There is a lack of literature following up on interventions to tick-borne disease management issues and TBD education programs, and evaluations should be partaken to ensure that interventions and communication strategies are functioning to the fullest of their potential. The implementation and analysis of a prevention program could be a potential
next step of research to be undertaken within Acadia National Park, due to the chance of tick exposure and high visitation status in the park.

2.7. Conclusion

Visitors to Acadia National Park coming from regions endemic for Lyme and other tick-borne diseases ultimately proved to be more knowledgeable about general tick facts, utilized tick-check behaviors more often, and had higher overall TBD perceived risk scores than those respondents visiting from states that were not endemic for Lyme disease. Additionally, respondents from areas endemic for Lyme disease believed that climate change and overabundant white-tailed deer were to blame for increased tick presence, while non-endemic visitors were more neutral regarding these opinions. Based on these results, separate communication strategies targeting visitors from endemic and non-endemic regions may be necessary, given the significant differences in perception between the two groups. The implications of these findings may be transferable to studies in other national park systems that experience high rates of tick-bite exposure, as well as state-owned parks. Given the increasing cases of Lyme and other tick-borne diseases nationwide, this study satisfies a relevant need for more information related to how endemicity impacts human behavioral risk in recreation hotspots such as ANP, as well as important information related to how visitors utilize protective measures and preventive behaviors while recreating in national parks. Understanding how endemicity impacts visitors' knowledge, perceived risk, and usage of preventive behavior will better inform strategies to communicate risk information related to tick-diseases in Acadia and other national parks.


CHAPTER 3

RISK PERCEPTIONS OF TICK-BORNE DISEASE BY

MAINE RESIDENT OUTDOOR RECREATIONISTS

3.1. Abstract

Tick-borne diseases (TBDs) are among the most widespread vector-borne diseases in the United States. Maine, located in the far northeastern corner of the nation, is endemic for Lyme disease and sees increasing amounts of infected ticks and humans annually. The large amount of forest cover within the state and the popularity of outdoor recreation activities make residents especially vulnerable to contracting Lyme and other TBDs. Expanding knowledge regarding TBDs and the use of preventive behaviors within the states’ residents is crucial to combating the spread of these diseases. However, there is limited understanding of how perceptions of risk influence different groups of residents in Maine. A sample of Maine resident outdoor recreationist received an invitation via mail to participate in an online survey. A total of 355 respondents completed the online questionnaire. Barriers against protective measures, behavioral frequency of these measures, and recreation tendencies were explored in the total sample. This study also investigated if differences in risk perceptions exist across respondents from various political backgrounds within the population. Results showed significant differences in total tick-borne disease knowledge and informational trust variables among respondents from diverse political backgrounds, with liberal respondents rating more highly in total knowledge and being slightly more trustworthy towards information sources rather than conservative respondents. These differences between political groups may have implications in the way tick-borne disease information is communicated in different scenarios. Interpreting and overcoming these gaps in
knowledge moving forward could enhance preventive measures against tick-borne diseases within Maine’s resident outdoor recreationists.

3.2. Introduction

The state of Maine has seen increased infections resulting from tick-borne diseases (Elias and Birkel, 2019; Smith et al., 2019). Lyme disease, in particular, is a cause of concern, seeing as it is the most common tick-borne disease in the United States (Centers for Disease Control, 2018). Lyme disease is caused by the bacterial spirochete *Borrelia burgdorferi*; it is transferred primarily through the bite of its main vector, the black-legged tick (*Ixodes scapularis*, Say 1821). The black-legged tick has been blamed for the increase of tick-borne disease cases in Maine since the early 90s (Elias et al., 2019). Other blacklegged tick-transmitted diseases such as Anaplasmosis, Babesiosis, Ehrlichiosis, and Powassan virus are becoming increasingly more common in the state. As a result, it is crucial to further develop public health management strategies that aid in the control of human exposure to tick-borne diseases and to promote the adoption of protective measures to combat tick bites (Piesman and Eisen, 2008).

In addition to comprehending the epidemiology of Lyme and other tick-borne diseases, it is important to understand what factors influence the adoption or lack of protective behaviors in respondents, and how their corresponding risk perceptions alter future behaviors and exposure risk. Past studies have found that certain factors are more predictive of tick-borne disease preventive behaviors, such as general knowledge and concerns about ticks and perceived bite risk (Herrington, 2004; Mowbray et al., 2014). Other research has focused on the social determinants of performing a tick check (van der Heijden et al., 2017). Roh et al., (2015) used temporal framing and motivated reasoning to investigate how members of different political parties viewed messaging about Lyme disease in the United States. Still, a gap exists in the
literature that investigates how socio-cultural factors such as education levels and political affiliations affect populations at risk for tick-borne diseases in Maine.

3.2.1. Conceptual Framing

The purpose of this study is to identify the risk perceptions of Maine resident recreationists towards tick-borne diseases in general. Other than assessing respondents’ knowledge of ticks and tick-borne diseases, it is important to understand the barriers and motivations behind using protective measures or performing preventive behaviors. Protective measures are the actions a person can take to reduce their risk (Slunge and Boman, 2018). Barriers refer to negative factors that may minimize the ability of a respondent to adopt a protective measure (Eisen and Stafford, 2020). Motivations are the individual beliefs driving a person to pursue or not pursue a certain behavior (Van Der Heijen et al., 2020). Perceived susceptibility refers to a respondent’s self-assessment of their own vulnerability. Protective measures, barriers, susceptibility, and motivations all can be described as individual beliefs, and can therefore be influenced by numerous modifying factors (Bosch et al., 2010). Social factors such as trust in information sources, values, and political affiliations have been surmised to act as determinants on health behavior adoption (Clarke 2009; Roh et al., 2015). These modifying factors can be assessed against individual beliefs such as perceived barriers and perceived susceptibility in order to create a more complete/comprehensive understanding of risk perceptions (Janz et al, 2002; Bosch et al., 2010). Roh et al., (2015), investigated how political affiliation affects temporal framing and reasoning behind wildlife disease risk. Exploring differences based on respondents’ political affiliations could potentially offer insights on how participants of differing political groups perceive risk, barriers to protective behaviors, and process information. In Europe, the transition between Soviet rule to democratic governmental
systems has been linked to the increase of the TBD tick-borne encephalitis (Randolph, 2008; Sumilo et al., 2009). Considering the increasingly polarized nature of political identity in the United States (Gollust et al., 2009; Conway et al., 2020), understanding differences among these groups may be integral to creating successful future public health campaigns and large-scale interventions. Although political leaning is not typically used for analysis in risk-perception models, the recent inclusion of climate change models in similar studies (van der Linden, 2015; Roh et al., 2015) and the polarization of perceptions and behaviors in the recent pandemic, suggest that using political affiliation as a classification tool to explore differences across groups may be useful.

The ensuing survey has been adapted from research that has utilized similar constructs from the Health Belief Model (HBM) and the Zoonotic Disease Risk Information Seeking and Processing (ZDRISP) framework (Bayles, 2013; Bosch et al., 2010; Clarke, 2009; Hanisch-Kirkbride, Riley, and Gore 2013). Details about the usages of these models, including our iteration of the combined HBM/ZDRISP model, can be found in Chapter One. Specifically, we have pulled wildlife values, trust in tick-borne disease information sources, and political affiliation from this model to use within the methodologies of this chapter.

This study seeks to determine the extent as to which socio-demographic categorization, specifically political affiliation, plays a role in determining the risk perceptions of Maine resident outdoor recreationists towards tick-borne diseases. We will explore how identifying with a particular political viewpoint influences risk perception-- hence creating a more complete understanding of predisposing factors related to knowledge of disease, uptake of preventive behaviors. We also will report on results for the total sample of respondents (N=355).
We hypothesize that political affiliation will have an effect on several variables, with Liberals having higher fact-based knowledge and may be more trusting of information sources (Gollust et al., 2009). However, we expect both Liberals and Conservatives to be concerned about tick-borne diseases and to score relatively similar on preventive behavior usage. Liberals may see tick-borne diseases as a more urgent concern to deal with presently, and Conservatives will also be concerned, but may feel that controlling the expansion of ticks is less urgent (Roh et al., 2015). These hypotheses are drawn from conclusions derived from the HBM and ZDRISP models described in Chapter One (Bayles, 2013; Bosch et al., 2010; Clarke, 2009; Hanisch-Kirkbride, Riley, and Gore 2013).

3.2.2. Maine Resident Outdoor Recreationists

Outdoor recreationists are defined as those who partake in activities involving natural resources for their leisure (Kerlinger et al., 2013). These activities include hunting, fishing, wildlife-watching, and hiking, among other recreational pursuits. Maine, as a state, puts a high value on the cultural and economic impact of the outdoor recreation economy. On average, outdoor recreation activities generate about $8.2 billion in annual consumer spending in Maine (Maine State Comprehensive Outdoor Recreation Plan, 2020). According to the 2009-2014 SCORP report, Mainers participate in the following activities higher than the national or regional average: primitive camping, big-game hunting, snow activities, snowmobiling, boating/canoeing, cold-water fishing, wildlife viewing, and foraging (Maine State Comprehensive Outdoor Recreation Plan, 2020). Maine state parks have also seen an increase in average day use of 10 percent when compared to 2009-2013 levels. The COVID-19 pandemic may have played a role in increased state-park visitation during the 2020 recreation season. According to a press release from the Maine Bureau of Parks and Lands (BPL), “In 2020, the BPL welcomed 2,786,750 day-
use visitors, up 74,532 (3%) from 2019; and 280,362 camping visitors, up 21,871 (8%) from 2019. Furthermore, 2018 edged out 2019 as the second-highest year for recreation visits, followed by 2016 and 2017” (Maine Department of Agriculture, Conservation, and Forestry, 2021).

The 2020 SCORP report also concluded that 97 percent of respondents visit outdoor recreation community sites multiple times per year, making Maine a more active state than the national average. Within this SCORP report, over 69 percent of respondents communicated trekking and hiking as their favorite outdoor recreation activity, which could imply that a large constituent of Maine recreationists will potentially be at risk of heightened tick-borne infection exposure (Maine State Comprehensive Outdoor Recreation Plan, 2020; Fischhoff et al., 2019). Moreover, 53 percent of surveyed recreationists preferred to stay overnight in camping tents within the state of Maine (Maine State Comprehensive Outdoor Recreation Plan, 2020). Since outdoor recreation inherently exposes residents to nature, entomological risks— or exposure to areas with higher than average vectors—are always possible (Piacentino and Schwartz, 2002; Maine State Comprehensive Outdoor Recreation Plan, 2020). Entomological risks may be increased in outdoor recreation areas that experience large visitor to land density ratios, such as national and state parks (Donohue et al., 2015; Fischhoff et al., 2019). Since Maine is a high-value recreation state, residents may be more exposed to vectors of disease than in other, less outdoor-recreation oriented states.

3.3. Methods

3.3.1. Study Area

Maine is the ideal study site for researching tick-borne diseases because of the high annual prevalence of confirmed infections, but also because Maine is home to several
ecosystems that are well suited to propagating life cycles of many species of ticks. The state has seen a continuous increase in the amount of reported TBD infections as well as increased tick abundance since the early 90’s (Rand et al., 2007; Smith et al., 2019). Maine is home to 104 identified natural community types, including various mixed woodland and wetland biomes, alpine areas, coastal zones, and even blueberry barrens (Maine Natural Areas Program, 2013). In addition to offering a plethora of nature-based activities, Maine is one of the most forested states in the nation, with 89 percent forest cover (Butler, 2016). Maine is also one of the least populated states, with only 1.3 million people in residence (US Census, 2019), however, Maine welcomes 22 million overnight visitors annually, especially in the summer months (Maine Office of Tourism, 2019). The presence of forest habitat, coupled with scattered suburban landscapes and seasonality that correlates with the black-legged tick’s life cycle, makes Maine an unfortunately ideal area for ticks to inhabit (Ostfeld et al., 2018). Lubelczyk et al., (2004), used multivariate regression analyses to determine that areas of denser shrub layer, closed forest canopy, deciduous leaf litter, forest grasses, and invasive Japanese barberry Berberis thunbergii (D.C.) were related to a higher probability of tick abundance.

Additionally, Maine experiences high levels of visitation and outdoor recreation numbers in the summer and fall, which correlate with the seasons of increased tick infection rates (Maine CDC, 2020; Maine Office of Tourism, 2019). Still, Maine residents have higher wildlife and outdoor recreation values than residents in other states, and do participate in recreational activities throughout the state year-round (Dietsch et al., 2018; Maine State Comprehensive Outdoor Recreation Plan, 2020).

In a series of surveys conducted by the Maine Department of Agriculture, Conservation, and Forestry, several specific and broader outdoor recreation sites within the states were found to
be popular amongst survey respondents. City and town parks, Maine state parks, and outdoor sports spaces were found to be the most popular visiting sites, with Baxter State Park, U.S. Fish and Wildlife refuges, and water trails deemed to be the least visited sites (Maine State Comprehensive Outdoor Recreation Plan, 2020). These results are shown in Table 3.1 below.

Based on this report, several of the sites noted were incorporated into our ensuing survey, among other popular Maine recreational destinations.

Table 3.1: Most popular recreation sites in Maine (image adapted from Maine State Comprehensive Outdoor Recreation Plan, 2020).

<table>
<thead>
<tr>
<th>Site/Site Type</th>
<th>Percent of survey respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Town/city parks &amp; open spaces</td>
<td>88%</td>
</tr>
<tr>
<td>Maine state parks &amp; historic sites</td>
<td>78%</td>
</tr>
<tr>
<td>Local outdoor sports &amp; recreation spaces</td>
<td>75%</td>
</tr>
<tr>
<td>Acadia National Park</td>
<td>61%</td>
</tr>
<tr>
<td>Farm/agricultural sites open to public visitation</td>
<td>61%</td>
</tr>
<tr>
<td>Land trust properties</td>
<td>60%</td>
</tr>
<tr>
<td>Maine DIFW wildlife management areas</td>
<td>57%</td>
</tr>
<tr>
<td>Private forest land open for recreation</td>
<td>52%</td>
</tr>
<tr>
<td>Maine public lands</td>
<td>44%</td>
</tr>
<tr>
<td>White Mountain National Forest</td>
<td>40%</td>
</tr>
<tr>
<td>Baxter State Park</td>
<td>33%</td>
</tr>
<tr>
<td>U.S. Fish &amp; Wildlife refuges</td>
<td>28%</td>
</tr>
<tr>
<td>Water trails (e.g., Maine Island trail, Northern Forest Canoe Trail)</td>
<td>25%</td>
</tr>
</tbody>
</table>
3.3.2. Survey Design

An online survey of Maine resident outdoor recreationists was conducted from September to December 2020. The instrument was constructed on the Qualtrics software platform. Prior to the implementation of the survey, the instrument was pretested by twenty-five participants in order to reduce measurement error (Dillman, Smyth, and Christian, 2014; Visser, Krosnick, and Lavrakas, 2000).

A random sample of Maine residents that actively engage in outdoor recreation was purchased through INFO USA. The mailing process consisted of an initial invitation to the 3,000 Maine resident recreationists in the sample. This invitation letter (Appendix C) included a link to access the questionnaire online as well as an individual access code for the respondent to input as a unique identifier when prompted during the online survey. The first invitations were sent out on September 17th, 2020 to 2,180 respondents. The next 820 invitations were sent out on October 8th, 2020. The delay in invitations was due to scheduling difficulties related to the COVID-19 pandemic.

To ensure maximum participation of respondents per Dillman (2014), a reminder notice (Appendix D) was sent to 1,921 potential respondents on October 17th, 2020 and 764 potential participants on November 8th, 2020. These mailings were staggered accordingly, with one month in between each subsequent mailing. Respondents that had completed the survey online or letters that had been returned were excluded from these second reminders.

A final reminder notice (Appendix D) was sent to 800 potential respondents on December 6th, 2020, approximately two weeks prior to the survey closing. Due to pandemic-related difficulties, it was decided to send the final reminder in one mailing, rather than staggered like the first two mailings. A total of 304 letters were classified as undeliverable, where the
respondent either no longer lived at the address, the letter was unable to be delivered, the address did not exist, or the respondent at the address was deceased. The final response rate was 13%.

Finally, to increase response rate, all respondents who completed the questionnaire were entered into a raffle for three $50 LL Bean gift cards as an incentive for participation (Dillman 2014).

3.3.3. Measures

The survey instrument included 37 questions separated into five sections described below.

Outdoor Recreation Behavior

Section one consisted of questions related to popular outdoor recreation activities, where respondents recreate by county, frequency of recreating outside, and one question that utilized a 5-point Likert scale to ask respondents how desirable certain natural settings were for recreating, with 2=very desirable and -2= very undesirable. These areas included backcountry trails, beaches, coastal trails, lighthouses and forts, community trails, farmlands, forests, lakes and ponds, mountains, playgrounds, and rivers. One question asked respondents to pick all activities that they participated in within the state since January 2019 out of a list of 25 outdoor recreation options. Respondents were also asked to check all national and state park areas they visited within the state since January 2019 from a list including Acadia National Park and Baxter State Park, among other popular recreation sites. The questionnaire also asked respondents about their preference for seasons to recreate within, as well as the frequency of recreation per season.

Tick and Tick-Borne Disease Knowledge

The second section included questions regarding general knowledge of ticks and tick-borne diseases. The first question in this section asked respondents to answer whether or not they know what a tick is. If the respondent answered no, they would be automatically redirected to section three. Another question required the respondent to identify a black-legged tick (labeled
deer-tick to avoid error bias) out of a selection of three photos. One photo portrayed a dog tick, another a black-legged tick, and a lone-star tick. Other than this question, each of the questions was derived from the 2019 Acadia National Park survey. Participants were asked questions regarding facts about ticks, Lyme disease, and other tick-borne diseases such as Anaplasmosis and Babesiosis. The non-tick-borne disease West Nile Virus was presented to see if respondents could distinguish a non-TBD from other zoonotic diseases. These questions included fact-based knowledge (e.g., Which of the following diseases are transmitted by ticks in Maine?), statements about Lyme disease (e.g., People can get Lyme disease after a tick bite), and identifying in which natural habitats people may encounter ticks that carry Lyme disease. These scores were compiled into a total tick knowledge score (low knowledge= 0 and high knowledge= 13).

**Protective Measures, Barriers, Trust, and Concerns**

Section three asked about protective measures to prevent tick bites, barriers to using preventive measures, and overall concerns about ticks. Respondents were asked whether or not they agree with certain statements related to tick-borne diseases. A 7-point Likert scale was utilized for this question, with 3 =strongly agree and -3= strongly disagree. Respondents were also asked how effective protective measures were to combat Lyme disease. A 5-point Likert scale was used, with 2= very effective and -2= not effective. Recreationists were asked how often they perform protective measures, with 2= always, 1= sometimes, and 0= never. These results were compiled into a total behavior frequency score where 0= low preventive behavior usage and 10= high preventive behavior use. Most of these questions were adapted from the previous 2019 survey as well as a 2018 survey at Acadia National Park (Soucy and De Urioste-Stone, 2020).
The next few questions asked how much respondents agreed or disagreed with statements about preventive behavior, trust in information related to tick-borne disease, and concerns related to tick-borne diseases using a 7-point Likert scale where 3= strongly agree and -3= strongly disagree. Respondents were asked to rate how much they trusted in TBD information reported by scientists, the federal government, the media, Maine Centers for Disease Control, University of Maine, and the Maine Medical Research institute. Trust scores were compiled using a 7-point Likert scale where -3= strongly disagree= low trust and 3= strongly agree= high trust.

Respondents were also asked whether or not concerns about tick-borne diseases had caused them to alter any behaviors. A 7-point Likert scale was used for this measure, with -3 representing “very unlikely” and 3 being “very likely”. Therefore, a low negative score (-3) reflects that a concern has not caused a behavior change, whereas a high positive score (3) reflects a change has occurred.

**Sociodemographics**

The final section included questions related to modifying factors such as age, income, gender, education (1=lower education, 2= higher education), Maine residential status, and political affiliation. The question regarding politics asked respondents “when it comes to politics, you consider yourself to be…” and allowed for the choice of one of six options: “Very liberal”, “Liberal”, “Basically independent, but leaning liberal”, “Basically independent but leaning conservative”, “Conservative”, and “Very Conservative”. These were recoded into two groups: Conservatives and Liberals.

**3.4. Data Analysis**

A total of 355 respondents completed the online questionnaire, contributing to a 13 percent total response rate. Further discussion regarding this response rate will be elaborated
upon the conclusion. Non-response bias was calculated by segmenting the respondents into “early” and “late” respondents (Filion, 1976; Soucy et al., 2020). Variables used for testing non-response bias included socio-demographics (gender, education, and politics), trust variables, efficacy variables, concerns due to TBDs, knowledge, and preventive behavior usage. The quarter of early respondents were compared to the quarter of late respondents. No significant differences were found between the early and late responders. No significant outliers were found within the data.

Descriptive statistics were utilized to investigate respondents’ concerns regarding tick-borne diseases as well as adoption of preventive behaviors such as tick checks and using insecticides. Descriptive statistics are also reported for recreation tendencies, knowledge of ticks and tick-borne diseases, barriers to protective measure uptake, and trust in information sources. Means, sample sizes, and standard deviations have been reported for all statistical measures.

Respondents were categorized into two main groups: Conservatives and Liberals. To maximize N power, Independents were moved into the two traditional political groupings based on documented political leanings (whether they leaned liberal or conservative as independents). Chi-square tests were used to investigate if differences in gender and education level existed among Maine resident recreationists from different political leanings. The Pearson chi-square correlation coefficient and Cramer’s V were reported for effect size.

Independent sample-T tests were conducted to compare differences in total tick-borne disease knowledge and trust in informational sources by political groups. The trust variables included information reported by scientists, the federal government, the media, Maine Centers for Disease Control, University of Maine, and the Maine Medical Research institute. As reported in the measures section above, the total tick-borne disease knowledge score included questions
about tick facts, Lyme disease, and general zoonotic disease. Levene’s statistic was used to test
the assumption of variances among groups, with the null hypothesis being that differences did
not exist between conservatives and liberals. In the case of Levene’s statistic being violated, the
equal variances not assumed measure was reported instead (Brown and Forsythe, 1974). Cohen’s
d was reported to assess independent sample effect size (Cohen, 1988). All tests were conducted
using SPSS v. 27.

3.5. Results

Outdoor Recreation Behavior

As seen below in table 3.2, the three most popular natural recreation settings for our
sample were lakes and ponds followed by beaches and coastal trails. The least popular areas
were playgrounds, farmlands, and backcountry trails.

Table 3.3 represents the number of respondents who visited recreation sites in Maine.
The three most popular sites were local municipal parks and open spaces, Maine state parks and
state historic sites, and private lands open for recreation. The top two results from this survey
matched the results of the 2020 Maine State Comprehensive Outdoor Plan. Our three least
popular sites were Baxter State Park, U.S. Fish and Wildlife Refuges, and White Mountain

<table>
<thead>
<tr>
<th>Recreation area</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backcountry trails</td>
<td>348</td>
<td>1.03</td>
<td>.96</td>
</tr>
<tr>
<td>Beaches</td>
<td>351</td>
<td>1.33</td>
<td>.82</td>
</tr>
<tr>
<td>Coastal Trails</td>
<td>349</td>
<td>1.32</td>
<td>.83</td>
</tr>
<tr>
<td>Lighthouses and forts</td>
<td>351</td>
<td>1.24</td>
<td>.77</td>
</tr>
<tr>
<td>Community trails</td>
<td>351</td>
<td>1.20</td>
<td>.85</td>
</tr>
<tr>
<td>Farmlands</td>
<td>348</td>
<td>.62</td>
<td>.86</td>
</tr>
<tr>
<td>Forests</td>
<td>351</td>
<td>1.15</td>
<td>.89</td>
</tr>
<tr>
<td>Lakes and ponds</td>
<td>349</td>
<td>1.47</td>
<td>.73</td>
</tr>
<tr>
<td>Mountains</td>
<td>349</td>
<td>1.26</td>
<td>.87</td>
</tr>
<tr>
<td>Playgrounds</td>
<td>348</td>
<td>.01</td>
<td>.88</td>
</tr>
<tr>
<td>Rivers</td>
<td>351</td>
<td>1.16</td>
<td>.87</td>
</tr>
</tbody>
</table>
National Forest. These sites slightly differed in order of least popularity from the 2020 Maine State Comprehensive Outdoor Plan (SCORP), but both Baxter State Park and U.S. Fish and Wildlife Refuges were in the bottom three of the SCORP plan. These similarities show that our sample is representative of the larger population sample utilized in the SCORP plan.

**Table 3.3**: Number of respondents who visited Maine recreation sites (in order of popularity)

<table>
<thead>
<tr>
<th>Name of recreation site</th>
<th>Number of visiting respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local municipal parks and open spaces</td>
<td>254</td>
</tr>
<tr>
<td>Maine state parks and state historic sites</td>
<td>236</td>
</tr>
<tr>
<td>Private lands open for recreation</td>
<td>192</td>
</tr>
<tr>
<td>Properties owned by land trusts</td>
<td>190</td>
</tr>
<tr>
<td>Farms and other agricultural sites</td>
<td>149</td>
</tr>
<tr>
<td>Acadia National Park</td>
<td>123</td>
</tr>
<tr>
<td>Maine public reserve lands</td>
<td>103</td>
</tr>
<tr>
<td>White Mountain National Forest</td>
<td>80</td>
</tr>
<tr>
<td>U.S Fish and Wildlife Refuges</td>
<td>60</td>
</tr>
<tr>
<td>Baxter State Park</td>
<td>50</td>
</tr>
</tbody>
</table>

Knowledge about Ticks and TBDs

Table 3.4 below shows the results of a question asking respondents to correctly identify a “deer-tick” from three example photos. After discussion, the proper terminology of black-legged tick was deemed to give respondents an unfair bias considering the leg coloration of the tick.

**Table 3.4**: Percentage breakdown of tick photo-identification question

<table>
<thead>
<tr>
<th>Presented photograph</th>
<th>Common tick name</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Dog tick" /></td>
<td>Dog tick</td>
<td>17</td>
<td>5.2%</td>
</tr>
<tr>
<td><img src="image" alt="Blacklegged tick" /></td>
<td>Blacklegged tick (deer tick)</td>
<td>254</td>
<td>77.7%</td>
</tr>
</tbody>
</table>
species, and the term “deer-tick” was used for this particular measure instead. The majority of respondents (77.7%) were able to correctly identify the black-legged tick.

As seen in Table 3.5 below, respondents indicated that concerns about tick-borne diseases did cause them to begin performing tick checks (M= 2.14), but no other above average changes were reported. Maine resident recreationists were especially adamant that concerns about tick-borne disease have not caused them to spend less time outside (M= -1.60) and feel negatively towards wildlife (M= -1.55). Mainers were more neutral towards changing the places they recreate (M= -0.76) and changing the type of activities they participate in (M= -0.93).

Maine respondents were most likely to perform the protective measures of tick checks (M= 1.53) and wearing long-sleeved clothing (M= 1.30). Tucking pants into socks was the least frequently used protective behavior (M= 0.93). These results are shown in table 3.6 below.
Table 3.6: Mean frequency of protective measures in total sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing tick checks</td>
<td>347</td>
<td>1.53</td>
<td>.55</td>
</tr>
<tr>
<td>Wearing insect repellent</td>
<td>346</td>
<td>1.08</td>
<td>.58</td>
</tr>
<tr>
<td>Wearing long-sleeved shirts and pants</td>
<td>346</td>
<td>1.30</td>
<td>.57</td>
</tr>
<tr>
<td>Tucking pants into socks</td>
<td>346</td>
<td>0.93</td>
<td>.73</td>
</tr>
<tr>
<td>Showering after recreating outdoors</td>
<td>346</td>
<td>1.03</td>
<td>.62</td>
</tr>
</tbody>
</table>

As seen in table 3.7, the largest barrier to uptake of protective measures was that outdoor temperatures are often too warm for long-sleeved clothing (M= 1.04). All other variables were not associated as barriers to utilizing protective measures, with respondents not believing that neither the cost of clothing was too high (M= -1.43) or the cost of insecticides was too high (M= -1.28). The sample was more neutral towards there being a low chance of being bitten by a tick (M= -0.75) and less likely to accept the barrier of not knowing if protective measures actually work (M= -1.04).

Table 3.7: Barriers to protective measures in total sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too warm for long-sleeved clothing</td>
<td>343</td>
<td>1.04</td>
<td>1.67</td>
</tr>
<tr>
<td>Low chance of being bitten by a tick</td>
<td>345</td>
<td>-0.75</td>
<td>1.54</td>
</tr>
<tr>
<td>Don’t know if long-sleeves and other measures actually work</td>
<td>344</td>
<td>-1.04</td>
<td>1.50</td>
</tr>
<tr>
<td>Cost of clothing too high</td>
<td>345</td>
<td>-1.43</td>
<td>1.49</td>
</tr>
<tr>
<td>Cost of insecticides too high</td>
<td>345</td>
<td>-1.28</td>
<td>1.47</td>
</tr>
<tr>
<td>I forget about ticks when going outside</td>
<td>345</td>
<td>-0.72</td>
<td>1.78</td>
</tr>
</tbody>
</table>

The total sample of Maine residents sampled generally were most trustworthy of tick-borne disease information messaging delivered by scientists (M=2.36), the University of Maine (2.25), and the Centers for Disease Control (M= 2.24). They were most distrusting of the media (M= 0.76), as seen below in table 3.8.
Table 3.8: Trust in tick-borne information sources for total sample

<table>
<thead>
<tr>
<th>Variable (information source)</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientists</td>
<td>342</td>
<td>2.36</td>
<td>.87</td>
</tr>
<tr>
<td>Federal government</td>
<td>340</td>
<td>1.32</td>
<td>1.49</td>
</tr>
<tr>
<td>Media</td>
<td>342</td>
<td>0.76</td>
<td>1.63</td>
</tr>
<tr>
<td>Centers for Disease Control</td>
<td>341</td>
<td>2.24</td>
<td>1.08</td>
</tr>
<tr>
<td>University of Maine</td>
<td>342</td>
<td>2.25</td>
<td>.92</td>
</tr>
<tr>
<td>Maine Medical Research Institute</td>
<td>343</td>
<td>1.97</td>
<td>1.12</td>
</tr>
</tbody>
</table>

Political group results

Respondents were grouped into conservatives and Liberals (Table 3.9). Differences between respondents of varying political groups were compared using chi-square and independent samples T-tests represented by Table 3.10 below.

Table 3.9: Explanation of political variable segmentation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservatives</td>
<td>Includes those who selected “very conservative”, “conservative”, and “mostly independent but leaning conservative”</td>
<td>145</td>
</tr>
<tr>
<td>Liberals</td>
<td>Includes those who selected “very liberal”, “liberal”, and “mostly independent but leaning liberal”</td>
<td>185</td>
</tr>
</tbody>
</table>

There was no significant difference between gender and political group ($\chi^2(3, N=330)=1.83, p=.61$). However, significant differences were found between education status and political group ($\chi^2(1, N=328)=12.92, p<=.001$). These results are represented by Table 3.10 below. The lower education group was found to be predominantly made up of conservative respondents. In comparison, the higher education group contained majority liberal respondents.

Table 3.10: Chi-square results of gender and education by political grouping

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample (%)</th>
<th>Liberals (%)</th>
<th>Conservatives (%)</th>
<th>Chi-square (sig)</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>135 (38.1%)</td>
<td>69 (20.9%)</td>
<td>62 (18.8%)</td>
<td>1.83 (.61)</td>
<td>0.74</td>
</tr>
<tr>
<td>Female</td>
<td>203 (57.3%)</td>
<td>113 (34.2%)</td>
<td>81 (24.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>5 (1.4%)</td>
<td>2 (0.6%)</td>
<td>2 (0.6%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Transgender</td>
<td>1 (0.3%)</td>
<td>1 (0.3%)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.10: Continued

Table 3.11 below shows the results of the independent samples t-test comparing total knowledge of tick-borne diseases among conservatives and liberals. There was a significant difference in knowledge among groups (t (286)=2.20, p= .04). Liberals averaged a higher knowledge score (M=6.34) than conservatives (M=5.65).

Table 3.11: Comparison of total tick-borne disease knowledge among political groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample average (N)</th>
<th>Liberals mean (N)</th>
<th>Conservatives mean (N)</th>
<th>Levene’s statistic (sig)</th>
<th>t-test (sig)</th>
<th>Cohen’s D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total TBD Knowledge</td>
<td>6.00 (304)</td>
<td>6.43 (164)</td>
<td>5.65 (124)</td>
<td>1.53 (2.18)</td>
<td>2.20 (.04)</td>
<td>.240</td>
</tr>
</tbody>
</table>

Results of independent samples t-tests revealed significant differences in levels of trust among political groups regarding dissemination of tick-borne disease information. As reported in Table 3.12, liberals were more likely to trust scientists, the federal government, the media, Maine CDC, University of Maine, and MMRI for information. Conservatives scored particularly low on media trust (M= .18); albeit, liberals received their lowest score for trust in media as well (M=1.26), (t(257.22)=6.09, p= <.001). The implications and importance of these findings will be elaborated upon in the discussion section. Scientists were the most trusted source of information for both liberals (M=2.66) and conservatives (M=1.99), (t(217.34)=7.00, p= <.001). These trends are displayed in Figure 3.1 below.
### Table 3.12: Comparison of trust variables by political group (scale -3 to 3)

<table>
<thead>
<tr>
<th>TBD trust in information source</th>
<th>Sample average (N)</th>
<th>Liberal mean (N)</th>
<th>Conservative mean (N)</th>
<th>Levene’s statistic (sig)</th>
<th>t-test (sig)</th>
<th>Cohen’s D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientists</td>
<td>2.34 (342)</td>
<td>2.66 (184)</td>
<td>1.99 (144)</td>
<td>10.23 (.002)</td>
<td>7.00 (.000)</td>
<td>.812</td>
</tr>
<tr>
<td>Federal government</td>
<td>1.32 (340)</td>
<td>1.50 (182)</td>
<td>1.13 (144)</td>
<td>.846 (.36)</td>
<td>2.32 (.02)</td>
<td>1.50</td>
</tr>
<tr>
<td>Media</td>
<td>.76 (342)</td>
<td>1.26 (184)</td>
<td>.18 (144)</td>
<td>18.00 (.000)</td>
<td>6.09 (.001)</td>
<td>1.54</td>
</tr>
<tr>
<td>Maine CDC</td>
<td>2.24 (341)</td>
<td>2.60 (183)</td>
<td>1.82 (144)</td>
<td>27.94 (.000)</td>
<td>6.52 (.001)</td>
<td>1.01</td>
</tr>
<tr>
<td>University of Maine</td>
<td>2.25 (342)</td>
<td>2.51 (184)</td>
<td>1.95 (144)</td>
<td>1.96 (.16)</td>
<td>5.80 (.001)</td>
<td>.87</td>
</tr>
<tr>
<td>Maine Medical Research Institute</td>
<td>1.97 (343)</td>
<td>2.21 (185)</td>
<td>1.69 (144)</td>
<td>.57 (.45)</td>
<td>4.23 (.001)</td>
<td>1.09</td>
</tr>
</tbody>
</table>

**Figure 3.1:** Trends in trust among Liberals and Conservatives. Trust 1=scientists; Trust 2= federal government; Trust 3= media; Trust 4= Maine Centers for Disease Control; Trust 5= University of Maine; Trust 6= Maine Medical Research Institute (scale = -3 to 3)
3.6. Discussion

Maine is a four-season destination, with outdoor recreation being one of the main draws for both residents and visitors to the state (Maine State Comprehensive Outdoor Recreation Plan, 2020). The state is densely forested, with approximately 89 percent cover (Butler, 2016). The combination of suitable tick habitats and outdoor activities being a popular past-time may create additional entomological risks for those within the state. Since outdoor recreationists are more likely to be exposed to ticks and therefore tick-borne diseases due to the inherent risks that exist when recreating in nature, understanding how political orientation may influence knowledge of tick-borne disease and trust in information sources may be important to re-evaluating how information is prepared and communicated. When compared to the 2020 SCORP report, our respondents placed similar values on recreation sites within the state of Maine, leading us to believe that our population is representative of the larger SCORP sample of Maine resident outdoor recreationists (Maine State Comprehensive Outdoor Recreation Plan, 2020).

As a whole, our sample population of Maine resident recreationists scored highly on species-specific tick identification, with approximately 77 percent of respondents able to correctly identify a blacklegged (deer) tick from a photo sample. Still, overall knowledge of ticks and tick-borne diseases was moderate, with the mean sample score being a 6.00 out of 13.00 on the survey knowledge scale. Moderate to higher TBD knowledge has been established as a significant predictor to performing tick checks, these results correspond with previous literature (Beaujean et al., 2013). Resident recreationists also largely did not let concerns about tick-borne diseases change certain behaviors and attitudes. This is in line with Jones (2015), who found that even with specific education targeting tick-borne disease risk in an endemic area, respondents were not likely to change their behaviors. Respondents did, however, choose to perform tick
checks as a result of concerns related to tick-borne diseases, which is similar to outcomes discussed in Aenishaenslin et al., (2017). This is promising, since tick checks are valuable and simple prevention methods (Vasquez, 2008).

Wildlife values were not affected by TBD concerns, and respondents largely did not change the types of activities they participated in, recreation locations, or spend less time outside as a result of TBD concerns. It is important that wildlife values did not decrease in the presence of increased ticks, since emerging threats of zoonotic diseases have tended to lower values towards wildlife conservation, and this is a key worry among One Health practitioners (Buttke, Decker, and Wild, 2015).

In a report conducted by Colorado State University alongside the U.S. Fish & Wildlife Service, Maine residents surveyed reported that they largely (74 percent of respondents) shared the same wildlife values as the Maine Department of Inland Fisheries & Wildlife. A total of 36 percent of respondents were classified as mutualists, meaning that they believed wildlife and humans should live together in harmony; 28 percent of respondents viewed wildlife as both a resource and a mutualistic partner, and 27 percent of respondents identified as traditionalists, therefore believing that wildlife should be managed for human benefit (Dietsch et al., 2018). Only nine percent of respondents did not report having wildlife values, meaning that the state overall showcased high values for wildlife in this particular report. This data suggests that Mainers do care about wildlife, yet questions remain as to how these values differ between political affiliations and in the context of tick-borne diseases and perhaps could be evaluated further in future studies.

Among the total sample, performing tick checks proved to be the most popular protective measure, followed closely by wearing long-sleeved clothing. Both performing tick checks and
wearing long-sleeved clothing tend to be the most popular preventive behaviors in previous literature reviewed (Butler et al., 2016; Aenishaenslin et al., 2015; Zöldi et al., 2017). Tucking pants into socks to avoid tick bites and showering after recreating outdoors were the least popular protective measures amongst our respondents (Omodior et al., 2015). Omodior et al., (2015), found that tucking pants into socks was the least common personal protective measure among survey respondents. Interestingly, even though utilizing long-sleeved clothing was a popular preventive behavior, it was also cited as the top barrier to uptake of protective measures among sampled respondents, whereas long-sleeved clothing being too warm itself was a barrier. Other barriers did not elicit significant results within the analysis.

Dividing the respondents into political leaning grouping did show differences in certain variables that were not evident by total sample results. There were significant differences in knowledge between liberals and conservatives, with liberals scoring above the sample average and conservatives below the sample average. These differences are difficult to explain without further research, since cognitive knowledge itself can be influenced by a variety of factors. A larger proportion of liberals did report having higher education (bachelor’s degree and higher), whereas conservatives were more evenly distributed between higher and lower education, with slightly more respondents in the lower education category.

While studies regarding the role of political affiliation and tick-borne disease risk perceptions are limited, recent studies have been dedicated to studying health risk perceptions and political orientation within the COVID-19 pandemic. Barrios and Hochberg (2020) found that conservatives do have drastically lower risk perceptions when compared to liberals, and reinforcing our stance that political affiliation will be an important contributing factor to future public health risk perception research.
Maine resident recreationists as a whole were most trusting of scientists to provide information related to TBD risk and prevention, and least trusting of the media (ie: journalists and public news sources). The most startling differences between the two political groups were highlighted by the results in the trust category of questions. Significant gaps did exist between how liberal and conservative recreationists processed information related to tick-borne diseases. Liberals were more trustworthy of outside information sources across the board, although it is important to note that conservatives did not score negatively on any of these scales (see Measures section for scale breakdowns). Liberals generally did not trust tick-borne disease information disseminated by the media, although conservatives did have lower trust levels here as well. The role of politics and informational trust have not been well studied in recent health literature, but Sakamoto (2018) conducted a literature review on challenges to tick-borne disease literacy in the general public and found that governmental websites largely tailored information towards scientists and practitioners, or included information on how to engage with the public without actively communicating with the public. Similarly, Larson et al., (2012), highlighted the need for research into vaccines and risk perception under different political contexts, citing the polarization and globalization of risk communication and perceptions.

Often, conservatives and liberals are portrayed as having differing health perceptions, but social psychology literature notes that conservatives usually have stronger connections to perceptions of health amidst physical disease threats (Crawford, 2017; Conway, Chan, and Woodard, 2019). Still, the COVID-19 pandemic has seen an increase in conservatives choosing to forgo health recommendations and the political party being less concerned about the pandemic compared to liberals (Conway et al., 2020). It is possible information processing is related to these discrepancies, and therefore implications to communication efforts should be expected.
Lower levels of trust in conservatives do support past conclusions regarding communication messaging about science and disease, primarily in information spread through the media (Taber and Lodge, 2006; Roh et al., 2015). This indicates that the delivery of information could potentially be one of the largest factors in creating health interventions that suit multiple groups. This political leaning divide, while perhaps not unexpected, does pose concerns regarding the future dissemination of public health knowledge. The low levels of media trust among both political groups observed in our research reiterates the need for more studies examining polarizing effects in media (Gollust et al., 2009). Further research dedicated to investigating partisan differences in knowledge and trust in information sources of Lyme and other tick-borne diseases is recommended. It is important to point out, however, that the respondents of this survey represent a very small facet of the overall population of Maine (<.01%).

While the results of this particular survey show differences between tick-borne disease knowledge rates and values of trust in differing political parties, this sample is small and may not be representative of the state as a whole. More studies should be implemented to verify these results with a larger sample. Future research can explore in more detail the determinants of risk perceptions and adoption of protective behaviors.

3.7. Conclusions

As discussed, the moderate knowledge and preventive behavior usage depicted within our study reflect findings from previous studies on tick-borne diseases and recreation. However, the trust value scale highlights a potential negative association between political values and information dissemination about tick-borne diseases. Given the increased polarization of
epidemiological health as exhibited by the COVID-19 pandemic crisis, further studies dedicated to examining why trust in public health information resources is declining may be warranted. Still, the lack of significant barriers to adopting preventive behaviors, uptake of tick-check behaviors, and moderate knowledge of our sample gives hope that even with lack of trust, Maine outdoor recreationists still are processing and using factual and useful information related to tick-borne disease prevention.
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CHAPTER 4

TICKED OFF! A COMPARATIVE ANALYSIS OF TICK-BORNE DISEASE

RISK PERCEPTIONS IN MAINE RESIDENT AND NON-RESIDENT OUTDOOR

RECREATIONISTS

4.1 Abstract

With 89 percent forest cover, more coastline than almost any other state, and the single national park in the northeastern United States, Maine is something of a recreationist’s paradise. Unfortunately, Maine also has numerous habitats suitable for black-legged ticks--the main vector of Lyme Disease. The state has seen increased rates of recorded and suspected Lyme Disease infections, but there is a lack of research related to how differing perceptions of recreation users may influence the human risks associated with recreating in high tick exposure regions. This chapter reviews the results of a comparative analysis conducted utilizing two separate surveys distributed to non-resident and resident respondents in Maine. Non-resident recreationists were found to have significant differences in the adoption of different preventative measures to combat tick-borne disease compared with Maine resident recreationists. Similarly, barriers to preventive measures were significantly lower among Maine residents. Still, non-resident recreationists showed higher levels of perceived efficacy in performing certain behaviors when compared to Mainers. The results of this analysis suggest that tailoring communication methods for different stakeholder groups may be necessary for better interventions related to tick-borne disease prevention.
4.2 Introduction

The increasing spread of Lyme disease worldwide has been attributed to climate and ecological factors (Brites-Neto, Duarte, & Martins, 2015; Stone, Tourand, & Brissette, 2017), yet there is a lack of research specifically in Maine regarding how human actions may influence their exposure to pathogens responsible for various tick-borne diseases. Reducing the risk of tick-borne diseases through the adoption of protective or preventive measures is integral to overall population health (Piesman & Eisen, 2008). Still, social behaviors can vary amongst individuals in differing regions (Bouchard et al., 2018), experiences with tick-borne disease (Aenishaenslin et al., 2014) as well as individuals with different recreational tendencies (Soucy & De Urioste-Stone, 2020).

Preventive tick-borne disease measures are defined as behaviors that can influence or decrease an individual’s risk of contracting a particular disease. Examples of these types of measures include checking exposed skin for ticks after recreating (tick checks) and using insect repellent prior to outside exposure. Other protective measures include wearing long-sleeved clothing when outdoors and tucking pants into socks to limit exposed skin (Hayes & Piesman, 2003). Slunge and Boman (2018) found that exposure to ticks and risk perceptions resulted in increased tendencies to perform tick checks, but not other preventive measures, meaning that differences in predisposing factors among different groups could result in differing levels of behavioral change. Butler et al., (2016) found that the perceived efficacy of a behavior was correlated with the subsequent performance of that preventive behavior. Commonly used in risk perception literature, perceived self-efficacy is an individual’s belief in their ability to reduce their risk of a certain condition or outcome as a result of altering or performing a behavior.
(Champion and Skinner, 2008; Beaujean et al., 2013; Donohue et al., 2018). However, our ensuing study focuses on efficacy of protective measures, also referred to as protection efficacy. Protection efficacy or the efficacy of a behavior refers to the belief of the success of a protective measure, and whether or not an individual believes a potential behavior to be beneficial or unbeneﬁcial (Azjen, 1991; Omodior et al., 2015; de la Fuente et al., 2020). Cognition, or knowledge, has also been linked to uptake of preventive behaviors (Herrington et al., 1997; Bayles, 2013). Herrington et al., (1997), found that perceived risk about acquiring Lyme, knowledge about Lyme, and believing Lyme to be a tangible problem all were factors that inﬂuenced the adoption of preventive behaviors. Concern about a particular disease-perceived risk—has also been found to inﬂuence the likeliness of performing tick checks and wearing insect repellent (Bayles, 2013).

This chapter aims to explore the similarities and differences in tick-borne disease risk perceptions between Maine resident and non-resident outdoor recreationists. As elaborated on in previous chapters, outdoor recreationists are deﬁned as people who enjoy one or more outdoor recreational activities on public or privately-owned lands. The objective of this comparison is to deﬁne potential barriers to preventive measures among the groups as well as to investigate which preventive behaviors are being utilized (or not being utilized) between residents and non-residents. Understanding how barriers to preventive measure uptake may vary among these groups could potentially highlight important information to share with different stakeholders regarding tick-borne diseases. These results may also potentially be transferable to other zoonoses, or pathogens spread from animal to human. Further, understanding on how barriers differ between residents and non-residents could help outdoor recreation planners and natural
resource managers in Maine tailor communication strategies regarding tick-borne disease information towards different groups

Before discussing the research questions for this chapter, it is important to review key results from each of the two surveys, as previously detailed in chapters two and three. Chapter two discusses a 2019 Acadia National Park survey which grouped recreationists based on endemicity for Lyme disease. In the context of this study, an endemic or high incidence state was one that experienced high numbers of Lyme disease cases, while a non-endemic state was low incidence, or did not experience many Lyme cases (Aenishaenslin et al., 2014; Slunge and Boman, 2018; Bouchard et al., 2018; Centers for Disease Control, 2018.) The results of these analyses revealed that respondents from endemic regions had higher levels of tick-borne disease knowledge, higher perceived risk, and were more likely to perform tick checks than visitors hailing from non-endemic areas.

Chapter three contains the results of a 2020 online survey targeting resident outdoor recreationists in the state of Maine. Here, respondents were primarily divided into two political groupings-- Conservatives and Liberals. Significant differences were observed in tick-borne disease knowledge and trust of informational sources, with Liberals being more knowledgeable about tick facts and generally more trusting of public information sources. Chapter three also presented that the overall sample showed that performing tick checks was the most popular protective measure, whereas tucking pants into socks was the least popular behavior. The overall knowledge score for this sample was only average, with the mean score being a 6 on a scale of 0 to 13.

Based on the previous surveys, I have determined the research questions for this chapter to be as follows:
1) Do barriers towards protective measure uptake differ significantly between Maine residents and non-residents? If so, which barriers are most prevalent for each group?

2) Which group will have the higher perceived risk score?

3) Which respondent group will have stronger perceived efficacy and how might these results influence future communication strategies?

The results of this comparative analysis will provide additional insight into how barriers, perceived efficacy, and protective measure uptake may differ between residents and non-residents to the state of Maine. Furthermore, results may highlight the necessity for new communication interventions.

4.3 Methods

First, a mixed-mode survey was conducted in Acadia National Park in 2019 of resident and non-resident recreationists. This survey is detailed at length in Chapter Two. Second, we conducted 2020 mailed survey of Maine resident recreationists (Chapter Three). We combined and integrated responses from the two separate survey samples by merging the two SPSS databases to compare and contrast similarities and differences between Maine resident and non-resident outdoor recreationist perceptions of risk, TBD knowledge, use of TBD preventive behavior, barriers to protective measures, and efficacy of measures. Only measures that were exact between the two surveys were used in the comparative analysis of the two groups. These measures are discussed in the next section.

4.3.1. Measures

Knowledge

Respondents were asked questions/statements related to ticks and tick-borne diseases (specifically Lyme disease). These questions included “Can tick bites cause Lyme disease”, “Are
ticks born with the pathogen that causes Lyme disease,” “Can rodents spread Lyme disease”, “The life cycle of the tick is three months”, “Ticks fall out of trees”, “Ticks hide in bushes”, and “Can humans spread the pathogen that causes Lyme disease”. These questions were recoded so that -1 = false, 0 = not sure, and 1 = true. The total of these questions was compiled into an overall knowledge score, where -1 indicates the lowest score (low knowledge) and 7 equated to the highest score (high knowledge). Respondents had to answer at least 4 out of the 7 questions in order to be included in the N used for this score.

Protective Measures

Participants were asked how often they performed tick checks, wore long-sleeved clothing, used insect repellent, and tucked pants into socks using a scale where 0 = never, 1 = sometimes, and 2 = always).

Barriers

Respondents were asked questions regarding barriers to adopting the aforementioned protective measures. A 7-point Likert scale was used, and responses were recorded so that -3 = strongly disagree and 3 = strongly agree. Barriers used included “too warm for long-sleeved clothing”, “low chance of being bit”, “cost of preventive product is too high”, and “I forget about ticks when recreating outside”.

Efficacy

Respondents were asked about the effectiveness of the following protective measures to prevent tick bites and Lyme disease: tick checks, long-sleeved clothing, tucking pants into socks, insect repellent, avoiding wooded areas, using pesticides on property, showering after recreating outdoors, mowing the lawn, and putting deer barriers on property. A 7-point Likert scale was also used for these questions, where -3 = not effective at all and 3 = extremely effective.
Perceived Risk

The survey respondents were asked their opinions on a series of statements to calculate perceived risk. These questions evaluated their opinions using a 7-point Likert scale (-3=strongly disagree, 3=strongly agree). These statements included “I am afraid of ticks”, “I worry about Lyme disease”, “I am at risk of contracting Lyme disease when recreating outdoors”, “Having an outdoor pet increases my risk for Lyme disease”, “I am disgusted by ticks”, “I believe Lyme disease is difficult to cure”, “I think Lyme is a serious condition”, and “I think there is a great chance I will contract Lyme after a tick bite”. A total perceived risk score was calculated based on the sum of the results of each collective statement (-8=low perceived risk, 16=high perceived risk). The total perceived risk score is reported in the results section below.

4.4. Data Analysis

The 2019 and 2020 datasets were downloaded separately from Qualtrics and imported into SPSS v. 27. There were 763 total respondents included in the comparative analysis. As seen in Table 4.1, respondents were relatively evenly divided between Maine resident recreationists (49%) and non-resident recreationists (51%).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maine resident recreationists</td>
<td>Residents of Maine who use public and private lands for recreational use</td>
<td>372 (49%)</td>
</tr>
<tr>
<td>(residents)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-residents</td>
<td>Residents from all other states who have visited Acadia National Park</td>
<td>391 (51%)</td>
</tr>
</tbody>
</table>

Respondents were coded into Maine residents (1) and non-residents (2). Chi-square tests were used to examine differences across groups in terms of perceived risk, perceived efficacy, the proportion of protective measure usage, and barriers against the uptake of preventive behaviors. The Pearson chi-square and Cramer’s V were reported for effect size (Sun et al.,
2010; Tomczak and Tomczak, 2014). Independent samples t-tests examined for differences in perceived risk between groups. Levene’s statistic tested the assumption of variances between groups (Brown and Forsythe, 1974). Cohen’s d was reported to assess independent sample effect size (Cohen, 1988). All tests were conducted in SPSS v. 27.

4.5. Results

Perceived Risk

Perceived risk was higher among Maine resident recreationists (M=8.21), with those respondents scoring over the sample average of 7.36 (Table 4.2). Non-residents, on the other hand, were below the sample average (M=6.00). Still, the range of score possibilities (-8 to 16) was quite varied, with the total respondents’ mean score not being particularly high or low. Independent t-tests revealed that resident Maine recreationists had significantly higher perceived risk than visitors to Maine (t(597) = 4.23, p= <.000).

Table 4.2: Total perceived risk score and t-test results by group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total respondents (N)</th>
<th>Residents (N)</th>
<th>Non-Residents (N)</th>
<th>Levene’s (sig)</th>
<th>T-test (sig)</th>
<th>Cohen’s D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived risk</td>
<td>7.36 (584)</td>
<td>8.21 (356)</td>
<td>6.00 (223)</td>
<td>4.23 (.04)</td>
<td>5.38 (.000)</td>
<td>4.68</td>
</tr>
</tbody>
</table>

Perceived Efficacy

As seen in Table 4.3 below, efficacy was particularly high for performing tick checks (M=4.53); and for wearing long-sleeved clothing (M=4.41). The effective measures that scored lowest for perceived efficacy were spraying pesticides on property (M=2.92) and putting deer barriers on personal property (M=2.88).

Perceived efficacy was significantly different across all preventive measures against tick-borne disease and tick bites, with non-resident recreationists consistently having higher
perceived efficacy scores than Maine resident recreationists (Table 4.3) for both performing tick checks ($\chi^2(4, N=756) = 21.331, p = .000$) and for wearing long-sleeved clothing ($\chi^2(4, N=758) = 57.68, p = .000$). Non-residents believed spraying pesticides ($\chi^2(4, N=754)=53.92, p=.000$) and putting deer barriers on personal property ($\chi^2(4, N=757)=98.94, p=.000$) were effective more so than Maine residents.

**Table 4.3:** Chi-square results of perceived efficacy

<table>
<thead>
<tr>
<th>Effective measure</th>
<th>Total respondent mean</th>
<th>Resident mean</th>
<th>Non-resident mean</th>
<th>Chi-square (sig)</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tick checks</td>
<td>4.53</td>
<td>4.43</td>
<td>4.63</td>
<td>21.33 (.000)</td>
<td>.168</td>
</tr>
<tr>
<td>Long-sleeved clothing</td>
<td>4.41</td>
<td>4.22</td>
<td>4.60</td>
<td>57.68 (.000)</td>
<td>.276</td>
</tr>
<tr>
<td>Tucking pants into socks</td>
<td>4.40</td>
<td>4.30</td>
<td>4.49</td>
<td>29.20 (.000)</td>
<td>.196</td>
</tr>
<tr>
<td>Staying on trails</td>
<td>3.88</td>
<td>3.56</td>
<td>4.17</td>
<td>101.36 (.000)</td>
<td>.365</td>
</tr>
<tr>
<td>Insect repellent</td>
<td>3.84</td>
<td>3.61</td>
<td>4.06</td>
<td>64.93 (.000)</td>
<td>.293</td>
</tr>
<tr>
<td>Avoiding wooded areas</td>
<td>3.61</td>
<td>3.46</td>
<td>3.76</td>
<td>35.29 (.000)</td>
<td>.216</td>
</tr>
<tr>
<td>Spraying pesticides onto property</td>
<td>2.92</td>
<td>2.72</td>
<td>3.13</td>
<td>53.92 (.000)</td>
<td>.267</td>
</tr>
<tr>
<td>Showering after recreating outdoors</td>
<td>3.60</td>
<td>3.56</td>
<td>3.64</td>
<td>18.33 (.001)</td>
<td>.156</td>
</tr>
<tr>
<td>Mowing the lawn</td>
<td>3.53</td>
<td>3.34</td>
<td>3.71</td>
<td>78.34 (.000)</td>
<td>.322</td>
</tr>
<tr>
<td>Putting deer barriers onto property</td>
<td>2.88</td>
<td>2.51</td>
<td>3.26</td>
<td>98.94 (.000)</td>
<td>.362</td>
</tr>
</tbody>
</table>

**Protective Measures**

Protective measure usage proved to only be significantly different across groups for certain behaviors (Table 4.4). Maine resident recreationists significantly performed more tick checks than non-residents when recreating outdoors ($\chi^2(2, N=588)=13.61, p=.001$). Similarly, Maine residents also significantly were more likely to perform the “tucking pants into socks” protective measure, ($\chi^2(2, N=693)= 37.57, p=.000$). While this difference was statistically significant, it is important to highlight that tucking pants into socks was the least popular protective measure for both groups, even though perceived efficacy for this particular measure
was high for both Mainers (M=4.30) and non-residents (M=4.49) (Table 4.3). This finding will be further discussed in the next section.

Unlike the previous mentioned measures, non-residents were more likely to wear insect repellent, although this difference was not statistically significant ($\chi^2(2, N=621)= .11, p=.946$). Mainers were more likely to adopt long-sleeve clothing into their recreational wardrobes, although this finding was not statistically significant either ($\chi^2(2, N=601)= 4.68, p=.096$).

**Table 4.4:** Chi-square results of protective measure usage

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total respondents (mean)</th>
<th>Residents (mean)</th>
<th>Non-residents (mean)</th>
<th>Chi-square (sig)</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing tick checks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>37</td>
<td>12</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>217</td>
<td>140</td>
<td>77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>334</td>
<td>202</td>
<td>132</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing insect repellent</td>
<td></td>
<td></td>
<td></td>
<td>.11 (.946)</td>
<td>.013</td>
</tr>
<tr>
<td>Never</td>
<td>90</td>
<td>53</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>397</td>
<td>230</td>
<td>167</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>134</td>
<td>76</td>
<td>58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing long-sleeved clothing</td>
<td></td>
<td></td>
<td></td>
<td>4.68 (.096)</td>
<td>.088</td>
</tr>
<tr>
<td>Never</td>
<td>35</td>
<td>21</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>375</td>
<td>210</td>
<td>165</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>191</td>
<td>125</td>
<td>66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tucking pants into socks</td>
<td></td>
<td></td>
<td></td>
<td>37.57 (.000)</td>
<td>.233</td>
</tr>
<tr>
<td>Never</td>
<td>290</td>
<td>116</td>
<td>174</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td>288</td>
<td>162</td>
<td>126</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>115</td>
<td>83</td>
<td>32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Overall, Mainers used preventive or protective measures more frequently than non-residents. These results are detailed in Table 4.4 above and Figure 4.1 below. Mainers were more likely to sometimes or always conduct tick checks, utilize long-sleeved clothing, and tuck their pants into socks to avoid tick bites. Non-residents were more likely to sometimes or always use insect repellent as a protective measure against tick bites and tick-borne diseases, but as previously mentioned, this result was not significant.

![Preventive Behavior Frequency by Residential Group](image)

**Figure 4.1**: Preventive behavior frequency of Maine residents vs. non-residents

**Barriers**

Four barriers tested proved to have statistically significant findings across each group (Table 4.5). Non-residents found that recreating outdoors made them “too warm” to wear protective gear, more so than Maine residents ($\chi^2(6, N=757) = 18.68, p=.005$). Generally, both groups disagreed that there was a “low chance of being bit” by a tick, but non-residents still were
more likely to take this gamble ($\chi^2(6, N=759) = 18.96, p=.004$). Mainers were more likely to disagree that the cost of purchasing new protective products was too high in comparison with non-residents ($\chi^2(6, N=759) =56.55, p=.000$). These barriers are illustrated in Figure 4.2 below.

**Table 4.5:** Chi-square results of barriers to preventive behavior

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Total respondents N (mean)</th>
<th>Residents N (mean)</th>
<th>Non-residents N (mean)</th>
<th>Chi-square (sig)</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too warm</td>
<td>760 (1.23)</td>
<td>366 (1.08)</td>
<td>391 (1.37)</td>
<td>18.68 (.005)</td>
<td>.157</td>
</tr>
<tr>
<td>Low chance of being bit</td>
<td>762 (-0.60)</td>
<td>368 (-0.77)</td>
<td>391 (-.44)</td>
<td>18.96 (.004)</td>
<td>.158</td>
</tr>
<tr>
<td>Cost of products too high</td>
<td>762 (-1.00)</td>
<td>368 (-1.38)</td>
<td>391 (-.65)</td>
<td>56.55 (.000)</td>
<td>.273</td>
</tr>
<tr>
<td>I forget about ticks when recreating outside</td>
<td>760 (-0.31)</td>
<td>369 (-0.69)</td>
<td>391 (.06)</td>
<td>64.55 (.000)</td>
<td>.292</td>
</tr>
</tbody>
</table>

**Figure 4.2:** Barriers against preventive measures between Maine residents and non-residents
**Knowledge**

Similar to the results in Chapters Two and Three, table 4.6 shows that the sample average for total knowledge was relatively equidistant (M=4.05) between the low end of the scale (-1) and the high end of the scale (7). This could be due to complexity of questions asked, lack of experiences related to tick-borne diseases, or other predisposing factors. Mainers had a lower overall knowledge score (M=3.47) than non-residents (M=4.89). Table 4.6 below represents this data.

**Table 4.6: Total sample knowledge statistics (scale -1 to 7)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample knowledge score</td>
<td>615</td>
<td>4.05</td>
<td>1.84</td>
</tr>
<tr>
<td>Maine resident knowledge score</td>
<td>357</td>
<td>3.47</td>
<td>.097</td>
</tr>
<tr>
<td>Non-resident knowledge score</td>
<td>252</td>
<td>4.89</td>
<td>.129</td>
</tr>
</tbody>
</table>

**4.6 Discussion**

Maine is a high-incidence Lyme disease state, and the rates of other tick-borne diseases within the state have been steadily increasing for the past few decades (Centers for Disease Control, 2018; Maine Centers for Disease Control, 2020). While both residents and non-residents in the state are aware of tick-borne diseases, challenges to the uptake of preventive behaviors, perceived risk, and perceived efficacy of protective measures have not been well documented within Maine. The results of this study act as a starting blueprint for understanding specific barriers to protective measure usage in Maine residents and non-residents traveling for outdoor recreation purposes. To review, we had three main research questions for this comparative analysis; 1) do barriers differ between Maine resident and non-resident outdoor recreationists, 2) which respondent group had higher perceived risk, and 3) which respondent group had greater efficacy or belief in the success of protective measures.
The results of our first research question showed that non-residents did have different barriers towards protective measure uptake when compared with Mainers. Non-residents were more likely to forget about ticks when recreating outdoors and therefore not perform protective measures, whereas Mainers did not see this as a barrier to preventive behavior usage at all. Both groups tended to agree that long-sleeved clothing was too warm and therefore a barrier to adoption of this preventive behavior when recreating outdoors, but non-residents were less likely to adopt long-sleeved clothing at all. Interestingly, neither group believed that the cost of tick control measures such as repellent and clothing were too high, although Mainers believed this significantly less. Both groups disagreed that there was a low chance of being bitten by ticks when recreating outdoors, but Mainers were more adamant about this not being a barrier than non-residents.

Our second question yielded interesting results. Maine residents perceived higher levels of risk towards tick-borne diseases ($M=8.21$) when compared to non-residents ($M=6.00$). Still, while statistically significant differences were found between groups, both of these scores straddled the overall group average on our perceived risk scale ($M=7.36$), which equates to only a moderate assumption of perceived risk. Risk perception of tick-borne diseases has also been connected to knowledge collected through living in a high-risk zone as well as knowing someone who has contracted a TBD (Aenishaenslin et al., 2014). Based on this reasoning, it is possible that Maine residents, being residents of a high incidence Lyme disease state, may have higher risk perceptions.

Risk perception of Lyme and other tick-borne diseases has been linked to higher preventive behavior usage and has been surmised to be linked to regional and recreational preferences (Herrington et al., 1997; Aenishaenslin et al., 2015). Maine residents having slightly
higher levels of perceived risk makes sense when put into the context of protective measure usage. Maine resident recreationists were significantly more likely to perform tick checks and tuck their pants into socks, and also more likely to wear long-sleeved clothing compared to non-residents. Non-residents were more likely to use insect repellents, however. High cognitive knowledge has been linked to lower acceptance of insect repellents and acaricides in some studies (Aenishaenslin et al., 2016), and non-residents surveyed did have higher tick and TBD knowledge than Mainers. Contradictory to this data though, high TBD knowledge has also been correlated with taking more preventive precautions (Daltroy et al., 2007). Further study in the Maine region may be necessary to determine the acceptability of insect repellents and acaricides as tick control measures in Maine.

Our third research question regarding efficacy proved to have the most complex outcome. Interestingly, even though Mainers performed more protective measures, they scored lower on the perceived efficacy of preventive tick control behaviors. This negative association between high protective measure usage and lower perceived efficacy goes against results recorded in previous literature. Butler et al., (2015), found that performing behaviors were highly correlated with belief in the effectiveness of those measures. Mowbray et al., (2014) also reported that efficacy was a predictor for higher willingness to perform tick control measures behaviors such as tick checks.

Still, since residents perceive risk at higher levels than non-residents, Mainers may still utilize protective measures even if they are doubtful in the efficacy of these behaviors. Van der Heijden et al., (2017) found that exposure to people who had contracted a TBD or personal experience with a TBD was linked to higher performance of the tick check behavior. This same study so it is entirely possible that experience with Lyme and other tick-borne diseases may
supersede any doubts about the efficacy of behaviors. More research is needed to justify this interesting result.

4.7. Conclusion

Tick-borne diseases such as Lyme, Anaplasmosis, and Babesiosis, among others, are all increasing in prevalence in the Northeastern United States. Still, the recurrence of these diseases is not a new phenomenon. Tick control measures are proven to be highly functional in lowering the personal risk of tick-borne diseases, but gaps still exist related to barriers limiting the uptake of protective measures and perceived risk of these diseases. There also seems to be a disconnect with Mainers between understanding risks of tick-borne diseases and performing certain behaviors, yet not actually believing in the efficacy of these protective measures. Further research of how Maine residents and non-residents perceive risk, efficacy, and barriers related to tick-borne diseases and protective measures, and the factors that determine perceive risk and use of protective measures is needed. Ultimately, information from this comparative analysis could help better understand how deficiencies in protective measure usage among different groups can be rectified through public-health interventions, health messaging and communication, and outreach.
REFERENCES


CHAPTER FIVE: CONCLUSION

5.1. Review of Key Results

The surveys that contributed to this thesis offered results that were both surprising and in line with previous literature. Chapter Two investigated whether endemicity could help identify differences amongst visitor groups in knowledge, risk perception, protective measures, and belief behind increased tick presence. Endemicity, or whether or not a state or region is a high incidence habitat for certain vectors of disease, proved to be a useful tool for analyzing differences in visitors to Acadia National Park. Visitors traveling from regions endemic for Lyme disease had higher levels of cognitive knowledge of ticks and tick-borne diseases, higher perceived risk, and utilized tick-check behaviors more often than visitors living in non-endemic or low incidence areas. Respondents from endemic or high incidence areas also reported that they believed climate change and overabundance of white-tailed deer were major factors contributing to increased presence of ticks in Maine, whereas visitors from low-incidence areas were neutral towards these two contributing factors.

In Chapter Three, we took a look at how political group affiliation and other sociodemographic groupings affected tick-borne disease knowledge, trust values, and perceived risk in Maine resident recreationists. Outdoor recreationists are respondents who actively spend time recreating in natural areas, resulting in perhaps higher entomological risk. Overall, the sample of Maine resident outdoor recreationists were able to correctly identify the main vector of Lyme disease, the black-legged tick, from a series of photos. Respondents largely did not let concerns about tick-borne disease influence their behavior or recreation choices, nor did
concerns affect wildlife values. However, respondents did choose to perform more tick checks as a result of tick-borne disease concern-- a promising data point.

When divided into groups by political affiliation, liberals scored higher on tick and tick-borne disease related knowledge in comparison with conservatives. Liberals also contained more respondents with higher levels of education. The greatest disparity in results existed within the trust variables. All groups were generally distrustful of media sources, but conservatives scored particularly low here. Still, even with some significant differences, overall there were not as many differences among political groups as hypothesized.

Chapter Four offered a comparative analysis featuring participants of the aforementioned surveys. The risk perceptions, perceived effectiveness of preventive behavior, protective measure usage, and barriers to preventive measures were compared between Maine residents and non-residents. Maine residents scored higher on a perceived risk scale, however both groups registered only a moderate amount of perceived risk. Maine residents were significantly more likely to perform tick-check behaviors and to tuck their pants into socks when recreating to prevent tick bites. Non-residents, however, chose to utilize insect repellent as a protective measure more often than Mainers. Both groups used long-sleeved clothing behaviors, although Maine residents slightly more so.

While Mainers chose to utilize more overall protective measures, they believed less in the efficacy or effectiveness of these behaviors; whereas non-residents perceived measures to be more effective in controlling tick bites and tick-borne diseases. Barriers were determined for both groups. Mainers cited long-sleeve clothing as being too warm, as did non-residents. The key difference in barriers was that non-residents reported that they would forget about ticks when recreating outdoors-- a point that Mainers were adamant against.
The amount of variance between respondent groups highlights the need for unique communication strategies to target different audiences. In the next section, I will focus on several strategies that may be implemented as outreach options to raise awareness of tick-borne diseases and potentially other vector-borne diseases.

5.2. Recommended Communication Strategies

Maine Residents Participating in Outdoor Recreation

Maine residents were cognizant of most knowledge related to outdoor recreation behavior and ticks and did report protective measure usage. However, they did not necessarily believe in the efficacy of measures. This can be rectified using a variety of communication strategies.

Infographics at State Parks and Other Recreation Sites

Mainers spend a large portion of their time outdoors, whether it be for high-intensity activities such as hiking or low-intensity recreational activities such as general sightseeing (Maine State Comprehensive Outdoor Recreation Plan, 2020). Installing visual and print infographics at popular recreation sites, such as a variety of state parks, could help raise awareness about specific protection measures that they may not necessarily feel confident about or have factual information pertaining to how to appropriately perform those measures. This option would also be helpful for park users of diverse political and educational backgrounds, since Mainers historically have reported strong wildlife values (Dietsch et al., 2018).

Newspaper and Online Op-Eds

Placing op-eds related to information regarding tick-borne disease knowledge and risk could work well for Mainers who participate in reading popular state and regional news outlets such as Portland Press Herald and the Bangor Daily News. However, it is important to note that both liberal and conservative groups of Maine residents were found to be largely mistrustful of
information shared through the media, so any op-ed should be supplemented with outreach of a different strategy. However, both groups placed higher levels of trust in scientists, the University of Maine, and Centers for Disease Control. As Sakamoto (2018) referenced in a literature review of outreach challenges related to Lyme disease literacy, many of these more scientific sources fail to actually communicate with the public, instead tailoring their communications towards scientists and other practitioners dealing with the public.

*Tick-borne Disease Poster Contests*

This strategy would target primarily school-aged children and young adults, and incentivize the adoption of protective measures through art contests. Broadening such a contest to include community members outside of the immediate school-system could be a way to make learning tick-borne disease knowledge more accessible and inclusive. Plus, art contests are a great way to involve multiple members of the family, rather than just targeting one specific age demographic. The Minnesota Centers for Disease Control has implemented one of these programs in their state, and Maine, as another high-incidence TBD state, could benefit from considering this strategy. Using creative services to benefit STEM-based education is a relatively new discipline, but perhaps future research could evaluate outcomes of such programming.

**Maine Residents-Interested Stakeholders**

*Email Newsletters*

In addition to infographics and newspaper op-eds, interested groups of stakeholders such as disease ecologists, landowners, and park officials may wish to be regularly informed on research. This provides a good opportunity to advertise conference proceedings and talks related to ongoing tick-borne disease research, perhaps through the circulation of a quarterly email
newsletter. Implementation of a newsletter would be a low-cost and inclusive way to reach multiple audiences with accurate scientific information, since we would be in full control of the information disseminated. This strategy would best reach either scientific audiences who are considered stakeholders within the zoonotic disease space OR general public audiences that specifically are looking to acquire more knowledge on Lyme and other tick-borne diseases, as being added to a listserv would be a crucial step to receiving this information.

**Visitors to Maine**

*Infographics and Postcards*

All of the above strategies may reach out-of-state visitors, but infographics in particular would be most effective towards non-resident outdoor recreationists. Notable areas that entertain out of state visitors include Acadia National Park, Baxter State Park, and the southern Maine beaches. Infographics related to tick-borne disease should be publicly displayed and available at major tourist and outdoor recreation sites and included in well-defined website sections pertaining to the natural area. Another potential way to distribute information to park-goers is through personalized post-cards that highlight a) high-incidence tick habitats b) tick identification and c) protective measures against tick bites and tick-borne diseases. Several example postcards are currently in development related to this communication strategy.

**5.3. Limitations and Looking into the Future**

Ultimately, the creation of this thesis was overshadowed by the COVID-19 pandemic, which impacted facets of this work. Chapter Three’s Maine Resident Recreationist survey was hindered by pandemic-related stressors. Additionally, the response rate to this survey was lower
in comparison with the Acadia National Park survey. Per evidence from prior research, the inclusion of an in-person intercept for the ANP survey prompted more respondents to complete the online portion (Dillman et al., 2014), whereas the survey that went out to Maine resident recreationists was strictly an online survey with no initial contact with the potential participants. While the ANP mixed-mode survey used intercept and then email follow ups, the Maine resident mail survey used a series of invitations and reminder postcards, all of which arrived through the US postal service. This delivery system may have contributed to the lower response rate because respondents had to hand type a link in from the paper letter or postcard onto their internet browser. This may have been difficult for older or visually impaired respondents. For future surveys, adding a barcode to the invitation and reminder postcards may assist in making the survey more accessible for wider audiences. Also, the US postal service was notably backed up in the fall of 2020 due to election pressures related to a massive increase in mail-in and absentee voting in the United States. This may have caused delays in surveys reaching their intended destinations.

The field of tick-borne disease is dense and full of opportunity for research and outreach, and unfortunately this thesis could only tackle a small facet of this subject. One portion of this thesis that did not come to fruition was the inclusion of a spatial analysis that used our visitor risk perception data combined with entomological risk data from a neighboring lab group. While this project did not end up being manageable for this particular piece of research, examining how behavioral and entomological risk coincide in certain areas is a worthy next step for tick-borne disease researchers. Another potential route of study relates to perceptions regarding the relationship between climate change and white-tailed deer with tick-borne disease risk, as well as further exploration of the importance of wildlife values to Mainers as touched upon in Chapter
Three. In addition to these proposed next research steps, implementation and assessment of the suggested communication strategies outlined in this chapter would also be useful, as would researching the efficacy of similar campaigns.

Zoonotic diseases are the most rapidly growing type of infectious disease worldwide (Wang and Crameri, 2014) and tick-borne diseases make up the bulk of vector-borne infections in the United States (Schwartz et al., 2017). As a result, it is crucial to understand not only the ecological drivers of disease, but the behavioral factors that make humans vulnerable to disease. In order to explore this intersect, we elaborated on the combined Health Belief Model/Zoonotic Disease Risk Information Seeking and Processing models used as the theoretical blueprint for the Maine resident recreationist survey specifically to better include elements essential to the One Health realm of study, including asking questions regarding wildlife values, public health informational trust, tick-borne disease knowledge, demographics of pet ownership, and other elements that exist on the crux of this new dimension of health-related research. This thesis is just one of a small, but increasing, abundance of studies that can be included under the One Health umbrella of research. My goal is that this thesis will provide much needed information on tick-borne disease knowledge, risk perceptions and protective behaviors while recreating outdoors that can be combined with future ecological studies in high-incidence tick environments in Maine and elsewhere. Thank you for reading, and please do not forget to perform your tick checks.
REFERENCES


APPENDIX A: 2019 ACADIA NATIONAL PARK SURVEY

5/1/2021

Quadraxis Survey Software

Block 1

PART A: In this section, we are interested to learn more about your recent trip to Acadia National Park, when you were approached by researchers from the University of Maine.

What was the primary purpose of your trip?
- Recreation
- Business trip
- Visiting family or friends
- Just passing through
- I am a permanent resident of the area
- Stay at our seasonal/timeshare residence in Mount Desert Island
- Other (Please specify)

Was this your first visit to Acadia National Park?
- Yes
- No

In which season do you most often visit Acadia National Park?
- Spring
- Summer
- Fall
- Winter

Why do you prefer to visit Acadia during this season? (Please select ALL that apply)
- Little or no mosquitoes present
- Little or no ticks present
- Off season—not too many visitors
- This is when I get time off
- Trees changing
- Weather
- Other (Please specify)
During this trip, how many nights did you spend at Acadia National Park (Mount Desert Island region)? (Please enter 0 if on a day trip)

Which recreational activities did you participate in during this trip to Acadia National Park? (Please select ALL that apply)

- Arts or cultural activity
- Backpacking
- Biking on carriage roads
- Biking on park motor roads
- Bird watching
- Boating
- Bus Tour
- Camping outside the park
- Camping at Seawall, Backwoods, Isle au Haut, or Wildwoods Stables Campgrounds
- Canoeing
- Concert or festival
- Dining at Jordan Pond House Restaurant
- Geocaching
- Going to the beach
- Fishing
- Golfing
- Hiking in a trail-less area (i.e., cross-country)
- Hiking on trails
- Kayaking
- Non-technical mountain climbing (i.e., without using ropes and special gear)
- Paddleboarding
- Picking berries
- Picnicking
- Sea kayaking
- Shopping in the park
- Sightseeing/driving for pleasure
- Speed hiking
- Swimming
- Taking horse and carriage ride
- Technical mountain climbing (i.e., using ropes and special gear)
- Trail running
- Viewing wildlife
- Walking on carriage roads
- Walked my dog
- Other (Please specify) ________________

Which was your primary recreational activity?

- Arts or cultural activity
- Backpacking
- Biking on carriage roads
- Biking on park motor roads
1. Bird watching
2. Boating
3. Bus Tour
4. Camping outside the park
5. Camping at Seawall, Backwoods, Isle au Haut, or Wildwoods Stables Campgrounds
6. Canoeing
7. Concert or festival
8. Dining at Jordan Pond House Restaurant
9. Geocaching
10. Going to the beach
11. Fishing
12. Golfing
13. Hiking in a trail-less area (i.e., cross-country)
14. Hiking on trails
15. Kayaking
16. Non-technical mountain climbing (i.e., without using ropes and special gear)
17. Paddleboarding
18. Picking berries
19. Picnicking
20. Sea kayaking
21. Shopping in the park
22. Sightseeing/driving for pleasure
23. Speed hiking
24. Swimming
25. Taking horse and carriage ride
26. Technical mountain climbing (i.e., using ropes and special gear)
27. Trail running
28. Viewing wildlife
29. Walking on carriage roads
30. Walked my dog
31. Other *(Please specify)*

During this trip, which of these places in Acadia National Park did you and your personal group visit? Use the map below to help you locate the places. *(Please select ALL that apply)*

- Bass Harbor Head Light Lighthouse
- Otter Cliffs
- Acadia Mountain (Ledges) parking area
- Pretty Marsh Picnic area
Baker Island
☐ Beehive
☐ Beech Mountain area
☐ Bubble Pond
☐ Bubble Rock
☐ Cadillac Mountain summit
☐ Champlain Mountain
☐ Hulls Cove Visitor Center
☐ Eagle Lake parking area
☐ Echo Lake Beach
☐ Islesford Museum
☐ Isle au Haut
☐ Jordan Pond House and area

Sand Beach
☐ Sargent Drive
☐ Schoodic Peninsula
☐ Schooner Head
☐ Seawall area
☐ Sieur de Monts area (Wild Gardens, Nature Center, Abbe Museum)
☐ Thomson Island picnic area
☐ Thunder Hole
☐ Valley Cove area
☐ Western Mountain Road
☐ Wildwood Stables
☐ Other (Please specify) [ ]
During this trip, which trails in Acadia National Park did you and your personal group visit? (Please select ALL that apply)

- Bald Peak and Parkman Mountain (lake and forest trail)
- Beachcroft and Champlain South Ridge (summit trail)
- Beech Mountain and South Ridge Loop (lake and forest trail)
- Beehive Loop (summit trail)
- Cadillac Mountain North Ridge (summit trail)
- Jordan Cliffs Loop (lake and forest trail)
- Jordan Pond Path (lake and forest trail)
- Long Pond and Great Notch Trail (lake and forest trail)
- Norumbega Mountain Loop (lake and forest trail)
- North Bubble Loop (lake and forest trail)
- Cadillac Mountain South Ridge (summit trail)
- Canada Cliff's Loop (lake and forest trail)
- Dorr Mountain South Ridge Loop (summit trail)
- Eagle Lake and Conners Nubble Trail (lake and forest trail)
- Flying Mountain Loop (coastal trail)
- Giant Slide Loop (summit trail)
- Gorham Mountain Loop (coastal trail)
- Great Meadow Loop (lake and forest trail)
- Great Head Trail (coastal trail)
- Gorge and A Murray Young Path Route (lake and forest trail)
- Jesup Path and Hemlock Road Loop (lake and forest trail)
- Ocean Path (coastal trail)
- Pemetic Mountain Loop (summit trail)
- Penobscot and Sargent Mountain Loop (summit trail)
- Perpendicular and Razorback Loop (lake and forest trail)
- Precipice Loop (summit trail)
- Saint Sauveur and Acadia Mountain (summit trail)
- Ship Harbor Trail (coastal trail)
- Triad Trail (summit trail)
- Wonderland Trail (coastal trail)
- Other *(Please specify)*

**Block 2**

**PART B: In this section, we are interested to learn more about your knowledge and practices as they relate to ticks and tick-borne diseases.**

Do you know what a tick is?
- Yes
- Maybe
- No

The following statements talk about ticks. Please select the option that best reflects your knowledge.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ticks' life cycle lasts 3 months</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
All types of ticks cause diseases to humans

During the summer, the chance of tick bites is higher compared to the winter

Ticks mostly fall out of trees

Ticks wait in shrubs/tall grasses

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>All types of ticks cause diseases to humans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During the summer, the chance of tick bites is higher compared to the winter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticks mostly fall out of trees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticks wait in shrubs/tall grasses</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Which of the following diseases are transmitted by ticks in Maine? (Please select ALL that apply)**

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaplasmosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Babesiosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dengue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lyme disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powassan Virus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Nile Virus</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following statements talk about Lyme disease. Please select the option that best reflects your knowledge.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>People can get Lyme disease after a tick bite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticks are born infected with the pathogen that causes Lyme disease</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Ticks get infected with the pathogen that causes Lyme disease from biting people who are infected with Lyme disease

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Ticks get infected with the pathogen that causes Lyme disease from biting mice and other small mammals that are infected with the disease

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### In which of the following types of habitats are ticks that carry Lyme disease more likely to be found in Maine? *(Please select ALL that apply)*

<table>
<thead>
<tr>
<th></th>
<th>Very Likely</th>
<th>Likely</th>
<th>Neither</th>
<th>Unlikely</th>
<th>Very Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardwood forests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paved roads</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Softwood forests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tall grass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The beach</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood chips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### How much do you agree or disagree with the following statements about tick bites and Lyme disease?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am afraid of ticks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am disgusted by ticks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I worry about Lyme disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Somewhat Agree</td>
<td>Neutral</td>
<td>Somewhat Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
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<td>---------</td>
<td>-------------------</td>
<td>---------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>Lyme disease would have a negative impact on my life</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>I believe Lyme disease is difficult to cure</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>I think Lyme disease is a serious condition</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>I think there is a great chance that I will contract Lyme disease after a tick bite</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>I am at risk of contracting Lyme disease when recreating outdoors</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>Having an outdoor pet increases my risk of contracting Lyme disease</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
</tr>
</tbody>
</table>

**How effective do you think the following measures are to help prevent tick bites/Lyme disease?**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Very Effective</th>
<th>Effective</th>
<th>Neutral</th>
<th>Not That Effective</th>
<th>Not at All Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examining yourself for ticks and removing them after being outdoors (i.e. a tick check)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Exercising regularly</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Thoroughly washing hands before eating</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Wearing long pants and long sleeved shirts when recreating outdoors</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Wearing gaiters in wooded areas</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Behavior</td>
<td>Very Effective</td>
<td>Effective</td>
<td>Neutral</td>
<td>Not That Effective</td>
<td>Not at All Effective</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>----------------</td>
<td>-----------</td>
<td>---------</td>
<td>--------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Tuck pants into socks in wooded areas</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Staying on pathways in wooded areas</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Using insect repellent</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Healthy eating habits</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Avoiding wooded areas</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Putting pesticides on property</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wearing sunscreen when spending time outside</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Taking a shower or bath after being in a wooded area</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Regularly mowing the lawn on your property</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Removing or sweeping the leaf litter on your property</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Putting up barriers to exclude deer on your property</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**How often do you practice/use the following precautionary behaviors to prevent ticks**

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Always</th>
<th>Usually</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform tick checks after being outside</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wear insect repellent</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wear protective clothing (such as long pants and long-sleeved shirts)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Tuck pants into socks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
How much do you agree or disagree with the following statements about BARRIERS to wearing protective clothing (such as long pants and long-sleeved shirts) to prevent tick bites/Lyme disease

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing protective clothing during the summer is too warm</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>There is a low chance of getting bit by a tick</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wearing protective clothing in nature is excessive</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>There is a low chance of getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Too little information is available on its usefulness</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The cost of purchasing new clothing is too high</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is bothersome</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is unpleasant to do</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I normally forget</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is too time consuming</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

How much do you agree or disagree with the following statements about your MOTIVATIONS to wear protective clothing (such as long pants and long-sleeved shirts) to prevent tick bites/Lyme disease

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>My degree of disgust of ticks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>My degree of fear of ticks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Somewhat Agree</td>
<td>Neither Agree nor Disagree</td>
<td>Somewhat Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
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<td>----------------</td>
<td>---------------------------</td>
<td>-------------------</td>
<td>---------</td>
<td>-------------------</td>
</tr>
<tr>
<td>The severity of Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The extent to which I am at risk of being bitten by a tick when I visit nature</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The benefits wearing protective clothing can yield, like not getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>How good I feel about myself when I wear protective clothing</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The high chance of getting bit by a tick</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Expert suggestions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wearing protective clothing prevents me from getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The benefits of wearing protective clothing are more important to me than the inconvenience it may cause</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

How much do you agree or disagree with the following statements about **wearing protective clothing** (such as long pants and long-sleeved shirts) to prevent tick bites/Lyme disease?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>People whose opinion I value will appreciate it if I wear protective clothing</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
### How much do you agree or disagree with the following statements about BARRIERS to tucking your pants into socks to prevent tick bites/Lyme disease

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tucking my pants into my socks during the summer is too warm</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>There is a low chance of getting bit by a tick</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Tucking pants into socks is excessive</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>There is a low chance of getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Too little information is available on its usefulness</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I don’t like the way it looks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Not effective</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>-----------------------------------------------</td>
<td>----------------</td>
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<td>----------------</td>
<td>----------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>I do not know how to do it effectively</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is bothersome</td>
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<td>○</td>
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<td>○</td>
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<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I normally forget</td>
<td>○</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is too time consuming</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**How much do you agree or disagree with the following statements about your MOTIVATIONS to tuck your pants into your socks to prevent tick bites/Lyme disease**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
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<tbody>
<tr>
<td>My degree of disgust of ticks</td>
<td>○</td>
<td>○</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The severity of Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>The extent to which I am at risk of being bitten by a tick when I visit nature</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The benefits tucking my pants into my socks can yield, like not getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>How good I feel about myself when I tuck my pants into my socks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The high chance of getting bit by a tick</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Expert suggestions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>--------------------------------------------------------------------------</td>
<td>----------------</td>
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<td>----------------</td>
<td>----------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Tucking my pants into my socks prevents me from getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The benefits of tucking my pants into my socks are more important to me than the inconvenience it may cause</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

How much do you agree or disagree with the following statements about tucking pants into your socks to prevent tick bites/Lyme disease?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>People whose opinion I value will appreciate it if I tuck my pants into my socks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>People whose opinion I value will disapprove if I tuck my pants into my socks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>People whose opinion I value tuck their pants into their socks while visiting nature</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Tucking my pants into my socks is important to me</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>After tucking my pants into my socks I feel good about myself</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
How much do you agree or disagree with the following statements about BARRIERS to using insect repellent to prevent tick bites/Lyme disease

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a low chance of getting bit by a tick</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>There is a low chance of getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I do not believe it is effective</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Do not like to use insect repellent products for my skin</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Using insect repellent skin products is excessive</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am not familiar with insect repellent skin products</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is bothersome</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is unpleasant to do</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I normally forget</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is too time consuming</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

How much do you agree or disagree with the following statements about your MOTIVATIONS to using insect repellent to prevent tick bites/Lyme disease

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>My degree of disgust of ticks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>My degree of fear of ticks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The severity of Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Statement</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Somewhat Agree</td>
<td>Neither Agree nor Disagree</td>
<td>Somewhat Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
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<td>----------------</td>
<td>---------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>The extent to which I am at risk of being bitten by a tick when I visit nature</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>The benefits using insect repellant can yield, like not getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>How good I feel about myself after using insect repellent</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>The high chance of getting bit by a tick</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Expert suggestions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Using insect repellent prevents me from getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>The benefits of using insect repellent are more important to me than the inconvenience it may cause</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

How much do you agree or disagree with the following statements about **using insect repellent to prevent tick bites/Lyme disease**?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>People whose opinion I value will appreciate it if I use insect repellent</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>People whose opinion I value will disapprove if I use insect repellent</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>People whose opinion I value use insect repellent while visiting nature</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Somewhat Agree</td>
<td>Neither Agree nor Disagree</td>
<td>Somewhat Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
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<td>---</td>
</tr>
<tr>
<td>Using insect repellent is important to me</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After using insect repellent I feel good about myself</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

How much do you agree or disagree with the following statements about BARRIERS to performing tick checks to prevent tick bites/Lyme disease

<table>
<thead>
<tr>
<th>There is a low chance of getting bit by a tick</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a low chance of getting Lyme disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Checking my skin after being outdoors is excessive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not know how to recognize a tick</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not know how to remove a tick</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is a low chance of getting Lyme disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not think it is effective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is bothersome</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is unpleasant to do</td>
<td></td>
<td></td>
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<tr>
<td>I normally forget</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is too time consuming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How much do you agree or disagree with the following statements about your MOTIVATIONS to performing a tick check to prevent tick bites/Lyme disease?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>My degree of disgust of ticks</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>My degree of fear of ticks</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The severity of Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The benefits performing a tick check can yield, like not getting Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>How good I feel about myself after performing a tick check</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The high chance of getting bit by a tick</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Expert suggestions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>A tick check is an effective way to prevent Lyme disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The benefits of doing a tick check are more important to me than the inconveniences it may cause</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

How much do you agree or disagree with the following statements about performing tick checks to prevent tick bites/Lyme disease?
<table>
<thead>
<tr>
<th>People whose opinion I value will appreciate it if I perform a tick check</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neither Agree or Disagree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>People whose opinion I value will disapprove if I perform a tick check</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>People whose opinion I value perform tick checks after visiting nature</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Performing a tick check is important to me</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>After performing a tick check I feel good about myself</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

**Concern about tick borne disease has caused me to:**

<table>
<thead>
<tr>
<th>Change my feelings about wildlife</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Does Not Apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change the types of outdoor activities I conduct</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Change the times of year that I recreate outdoors</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Change the times of day that I recreate outdoors</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Change the locations where I recreate outdoors</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Increase personal protection activities when recreating outdoors</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Keep my family out of tick-prone areas</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Activity</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Somewhat Agree</td>
<td>Neutral</td>
<td>Somewhat Disagree</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
<td>Does Not Apply</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------</td>
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<td>---------</td>
<td>-------------------</td>
<td>----------</td>
<td>------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Reduce my outdoor activity</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Stop recreating outdoors</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Other (Please specify)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**What do you do when finding a tick on yourself or family member? (Please select ALL that apply)**

- [ ] Burn tick off with a match
- [ ] Leave tick on until a doctor removes it
- [ ] Remove tick using nails
- [ ] Remove tick using oil
- [ ] Remove tick using tick spoon
- [ ] Remove tick using tweezers
- [ ] Rub alcohol on tick to remove it
- [ ] Unscrew tick to remove it
- [ ] Use nail polish to remove tick
- [ ] Use petroleum-based gel to remove tick
- [x] Other (Please specify)

**Of the following, which factors would you say are causing the greatest increase in ticks?**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available tick habitat</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Climate change</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Human development of landscapes</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Increased rodent populations</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Overabundant white-tailed deer</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Not sure</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Other (Please specify)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
**Have you, a close family member, or a close friend ever been diagnosed with any of the following tick-borne diseases? (Please select ALL that apply)**

<table>
<thead>
<tr>
<th></th>
<th>Myself</th>
<th>Close Family Member</th>
<th>Close Friend</th>
<th>Family Pet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaplasmosis</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Babesiosis</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Ehrlichiosis</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Lyme disease</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Powasan virus</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other (Please specify)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Did you find ticks while visiting Acadia National Park?**

- ☐ Yes
- ☐ No

**During this visit, which regions of the park did you find ticks at? (Please select ALL that apply)**

- ☐ Beech Mountain
- ☐ Blackwoods Campground
- ☐ Cadillac Mountain
- ☐ Echo Lake
- ☐ Hull’s Cove
- ☐ Jordan Pond
- ☐ Sand Beach
- ☐ Seawall Campground
- ☐ Sieur de Monts
- ☐ Other
  - ☐ [Name of Other Region]
- ☐ Not Sure

**During this visit, did you obtain any information about ticks and tick borne diseases?**

- ☐ Yes
- ☐ No
From which sources did you receive information about ticks and tick borne-diseases?  
(Please select ALL that apply)

☐ Acadia National Park website (www.nps.gov/acad)
☐ Other website
☐ Brochures by Acadia National Park
☐ Chamber of Commerce/Visitor Bureau/State Welcome Center
☐ Friends/Family/Word of mouth
☐ Hotel/campground
☐ Interpretive Signs at Acadia National Park
☐ Lifeguard
☐ Newspapers/Magazines
☐ Park Ranger
☐ Park Service Bulletin Boards
☐ Shopkeeper
☐ Television/Radio Programs/Videos
☐ Travel Guides/Tour Books (such as AAA, Lonely Planet, etc.)
☐ Other (Please specify)

Block 3

PART C: This final section of the survey will give us some background information about you, and demographics. Your answers to these questions, as with all other answers you provide in this questionnaire, will remain completely anonymous.

Are you male or female?

☐ Male
☐ Female
☐ Other
☐ Prefer not to answer

What is your age (in years)?

What is the highest level of school you have completed?
- Grade 8 or lower
- Some high school, no diploma
- High school diploma or equivalent
- Some college, no degree
- Associate degree
- Bachelor's degree
- Master's degree
- Professional degree
- Doctorate degree

Which category best represents your annual household income?
- Less than $24,999
- $25,000 to $34,999
- $35,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $149,999
- $150,000 to $199,999
- $200,000 or more

What ethnicity/race(s) do you consider yourself? *(Please select ALL that apply)*
- American Indian or Alaska Native
- Asian
- Black or African-American
- Hispanic
- Native Hawaiian or other Pacific Islander
- White

What language is most frequently spoken in your home?
- English
- Other

When it comes to politics, you generally consider yourself to be:
- Very Liberal
- Liberal
- Basically Independent, But Leaning Toward Liberal
Independent
○ Basically Independent, But Leaning Toward Conservative
○ Conservative
○ Very Conservative

Have you visited a National Park Service site before today?
○ Yes
○ No

On this visit, what kind of personal group (not guided tour/school group) are you with?
○ Alone
○ Family
○ Friends
○ Family and friends
○ Others (Please specify)

Which of the following best describes your residency on Mount Desert Island, Maine?
○ Permanent Resident
○ Summer Resident (returning annually for 1-6 months)
○ Not a Resident

If you are a resident of the United States, please enter the 5-digit zip code for where you currently live

Or

If you are a resident of a foreign country, please write the name of the country for where you live.

Are ticks and tick-borne diseases a concern where you live?
○ Yes
○ No

Please provide any final comments you may have about ticks and tick-borne diseases.
APPENDIX B: MAINE RECREATIONIST SURVEY

Please enter your assigned ID number (access code) from your invitation letter.

______________________________________________________________
Part A: In this section you will answer questions related to outdoor recreation and activities in the state of Maine.

Please rate your desirability for visiting each of the following natural settings in Maine.

<table>
<thead>
<tr>
<th>Natural Setting</th>
<th>Very Desirable</th>
<th>Desirable</th>
<th>Neutral</th>
<th>Undesirable</th>
<th>Very Undesirable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backcountry trails</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Beaches</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Coastal Trails</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Cultural Landmarks (lighthouses, forts, etc)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Community Trails</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Farmlands</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Forests</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Lakes/Ponds</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Mountains</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Playgrounds</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Rivers</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Which of the following outdoor recreation activities have you participated in since January 2019? Please click ALL that apply.

☐ Arts or cultural activity

☐ Backpacking

☐ Bicycling (including mountain biking)

☐ Bird Watching

☐ Boating

☐ Camping

☐ Canoeing

☐ Concert or Festival

☐ Geocaching

☐ Fishing

☐ Going to the Beach

☐ Golfing

☐ Hiking

☐ Hunting

☐ Kayaking
Mountain Climbing
Nature Photography
Paddleboarding
Picnicking
Picking Berries
Swimming
Taking Horse and Carriage Ride
Trail Running
Viewing Wildlife
Walking my Dog
Please indicate all of the following outdoor recreation/conservation sites that you have visited in Maine since January 2019. Please select ALL that apply.

☐ Acadia National Park

☐ Baxter State Park

☐ Farms and other agricultural sites open to the public

☐ Local municipal parks and open spaces

☐ Maine Public Reserve Lands (Bigelow Preserve, Donnell Pond, etc)

☐ Maine State Parks and State Historic Sites

☐ Private land open for recreation

☐ Properties owned by land trusts

☐ U.S. Fish and Wildlife Refuges

☐ White Mountain National Forest
Please rate the average frequency that you pursue outdoor recreation activities in Maine during each of the following seasons (based on a typical, non-pandemic year).

<table>
<thead>
<tr>
<th>Season</th>
<th>Daily</th>
<th>Every few days</th>
<th>Weekly</th>
<th>Every few weeks</th>
<th>Monthly</th>
<th>A few times during the year</th>
<th>Once during the year</th>
<th>Every few years</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>☐</td>
<td>☒</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Spring</td>
<td>☐</td>
<td>☒</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Summer</td>
<td>☐</td>
<td>☒</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Autumn/Fall</td>
<td>☐</td>
<td>☒</td>
<td>☒</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Please select the Maine county where you most often participated in outdoor recreation activities (since January 2019).

- Androscoggin
- Aroostook
- Cumberland
- Franklin
- Hancock
- Kennebec
- Knox
- Lincoln
- Oxford
- Penobscot
- Piscataquis
- Sagadahoc
- Somerset
- Waldo
- Washington
- York
- Not sure

End of Block: Recreation Questions

Start of Block: Knowledge of Ticks and Tick-Borne Diseases
PART B. This section includes questions about ticks and tick-borne diseases. Please answer each to the best of your ability.

Do you know what a tick is?

- Yes
- No

Please identify which of these ticks is a deer tick.

- Image:Download 1
- Image:Download
- Image:Download 2

The following statements talk about the deer tick. Please select the option that best reflects your knowledge.

<table>
<thead>
<tr>
<th>Statement</th>
<th>True</th>
<th>False</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>This tick’s life cycle generally lasts 3 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This tick can attach to humans by falling out of trees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>These ticks wait in shrubs/tall grasses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease</td>
<td>True</td>
<td>False</td>
<td>Not sure</td>
</tr>
<tr>
<td>------------------------</td>
<td>------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>Anaplasmosis</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Babesiosis</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Dengue</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Lyme Disease</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Powassan Virus</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>West Nile Virus</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
The following statements talk about **Lyme disease**. Please select the option that best reflects your knowledge.

<table>
<thead>
<tr>
<th>Statement</th>
<th>True</th>
<th>False</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>People can get Lyme disease after a tick bite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticks are born infected with the pathogen that causes Lyme disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticks get infected with the pathogen that causes Lyme disease by biting infected animals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticks get infected with the pathogen that causes Lyme disease by biting infected humans</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In which of the following types of habitats are ticks that carry *Lyme disease* more likely to be found in Maine? Please select ALL that apply.

- [ ] Beaches
- [ ] Gravel
- [ ] Hardwood forests (deciduous trees like Oak)
- [ ] Hiking trails
- [ ] Paved roads
- [ ] Rocks
- [ ] Softwood forests (conifers like Pine)
- [ ] Tall grass
- [ ] Wood chips or piles

End of Block: Knowledge of Ticks and Tick-Borne Diseases

Start of Block: Ticks and Preventive Measures

**Part C:** This section will ask you about measures to prevent tick bites, barriers to using preventive measures, and overall concerns about ticks.

"Preventive measures" refer to steps a person takes to avoid being bit by a tick or being infected with a tick-borne disease.
How much do you agree or disagree with the following statements regarding tick-borne diseases?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am afraid of ticks.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I worry about Lyme disease.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Lyme disease would have a negative impact on my life.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am at risk for contracting Lyme disease when recreating outdoors.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Having an outdoor pet increases my risk for tick-borne diseases.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am disgusted by ticks.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I believe Lyme disease is difficult to cure.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I think Lyme is a serious condition.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I think there is a great chance that I will contract</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

146
Lyme disease after a tick bite.
<table>
<thead>
<tr>
<th>Measure</th>
<th>Extremely Effective</th>
<th>Very Effective</th>
<th>Effective</th>
<th>Somewhat Effective</th>
<th>Not Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing a tick check.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Wearing long pants and long-sleeved shirts when recreating outdoors.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Tucking pants into socks when in a wooded area.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Staying on trails in wooded areas and parks.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Using insect repellent.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Avoiding wooded areas.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Spraying pesticides on property.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Taking a shower or bath after recreating in a wooded area.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Mowing the lawn on your property.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Putting up barriers to exclude deer.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
from your property.

End of Block: Ticks and Preventive Measures

Start of Block: Questions about Behaviors

**How much do you use the following behaviors to prevent tick bites and tick-borne diseases?**

<table>
<thead>
<tr>
<th></th>
<th>Always</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform tick checks after being outside.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wear insect repellent.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wear protective clothing (long sleeved shirts and pants)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuck pants into socks.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Showering immediately after recreating outdoors.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

End of Block: Questions about Behaviors

Start of Block: Barriers
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is too warm in the summer to wear long-sleeved clothes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is a low chance I'll be bitten by a tick.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don't know if long-sleeved clothing actually helps to prevent ticks.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cost of purchasing clothing is too high.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The cost of purchasing insecticides is too high.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I forget about ticks when going outside.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Start of Block: Benefits/Trust/Concerns
### How much do you agree or disagree on the following statements regarding trust and information about tick-borne diseases?

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I trust scientists for information on tick-borne diseases.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I trust the federal government for information on tick-borne diseases.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I trust the media for information on tick-borne diseases.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I trust the Maine Centers for Disease Control (CDC) for information on tick-borne diseases.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I trust the University of Maine for information on tick-borne diseases.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
I trust the Maine Medical Research Institute for information on tick-borne diseases.
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is more beneficial to wear protective clothing than to not.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tick prevention is useless.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerns about tick-borne diseases have caused me to feel negatively towards wildlife.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerns about tick-borne diseases have caused me to change the type of activities I participate in.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concerns about tick-borne diseases have caused me to change the places I recreate.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Concerns about tick-borne diseases have caused me to perform tick checks.

Concerns about tick-borne diseases have caused me to keep my family out of wooded areas.

Concerns about tick-borne diseases have caused me to spend less time outside.

End of Block: Benefits/Trust/Concerns

Start of Block: Other

**Part D:** This section includes questions about methods for removing ticks, owning pets, and your beliefs regarding causes of tick-borne diseases. Please answer all to the best of your ability.
What methods do you use to remove ticks? Please check ALL that apply.

☐ Burning Tick Off With a Match
☐ Leaving it for Doctor to Remove
☐ Removing Tick Using Nails
☐ Removing Tick Using Tick Spoon
☐ Removing Tick Using Tweezers
☐ Rub Alcohol on Tick to Remove
☐ Unscrew Tick to Remove
☐ Use Nail Polish to Remove
☐ Use Petroleum-Based Gel to Remove

Do you own a pet?

☐ Yes, a dog.
☐ Yes, a cat.
☐ No
How often do you perform tick checks on pets that go outside?

- Always
- Usually
- Sometimes
- Never

Do you believe your pet is at risk for contracting a tick-borne disease?

- Definitely yes
- Probably yes
- Might or might not
- Probably not
- Definitely not
Which do you blame for the increase of ticks in nature? Please select ALL that apply.

☐ Climate Change

☐ Increased Urban Development

☐ More Available Tick Habitat

☐ More Rodents and Small Mammals

☐ More White-Tailed deer

☐ I’m Not Sure

Have you or a close family member or friend been diagnosed with the following tick-borne diseases?

<table>
<thead>
<tr>
<th>Disease</th>
<th>Family Member</th>
<th>Friend</th>
<th>Myself</th>
<th>No one I know</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anasplasmosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lyme Disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Babesiosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powassan Virus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ehrlichiosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Please reflect your opinion on the following statements related to tick-borne diseases and other infectious diseases.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Neutral</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am concerned about infectious diseases.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am more concerned about infectious diseases now than I was before the COVID-19 outbreak.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I spend less time recreating outdoors now than before the COVID-19 outbreak.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tick-borne diseases are a problem that need to be dealt with now.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tick-borne diseases are a problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
that needs
to be
dealt with
ten years
from
now.

Tick-
borne
diseases
are not
that much
of an
issue for
me.

I am not
at risk of
getting a
tick-borne
disease.
From what sources do you obtain information about tick-borne diseases? Please check ALL that apply.

☐ Federal Government

☐ Friends and Family

☐ Maine CDC

☐ National or State Park Infographics

☐ Neighbors

☐ Newspapers

☐ Online News Websites

☐ Radio News

☐ Social Media

☐ Television (Broadcast News)

☐ Other (Please Specify) ____________________________________________________________

End of Block: Other

Start of Block: Demographics

Part E: This final section includes questions about demographics. Remember, all data is confidential and will NOT be shared.
Please indicate your current residential status.

- Full time resident of the state of Maine
- Seasonal resident of Maine (at least 6 months a year)
- Not a resident of the state of Maine

If you are a resident of Maine, please enter the five-digit zip code to your current address:

__________________________________________________________

If you are NOT a resident of Maine, please enter the five-digit zip code to your current address:

__________________________________________________________

What is your current gender identity?

- Female
- Male
- Non-Binary, Genderqueer, or Genderfluid
- Transgender-Female
- Transgender-Male
- Gender Identity Not Listed
- Prefer Not to Answer
What is your age (in years)?

________________________________________________________________

What is the highest level of school you have completed?

- Less than high school
- High school diploma or equivalent
- Some college, no degree
- Associate's degree
- Bachelor's degree
- Master's degree
- Doctorate

Which category best represents your annual household income?

- Less than $24,999
- $25,000 to $34,999
- $35,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $149,999
- $150,000 to $199,000
- Greater than $200,000
What ethnicities/races do you consider yourself? Please choose ALL that apply.

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic or Latin American
- Native Hawaiian or Pacific Islander
- White
- Other

When it comes to politics, do you consider yourself to be...

- Very Liberal
- Liberal
- Basically Independent, but leaning towards Liberal
- Basically Independent, but leaning towards Conservative
- Conservative
- Very Conservative

Congratulations! You have reached the end of this survey. Thank you for taking the time to participate. Upon completing this survey, you will be re-directed to a page where you will have the chance to submit your contact info for one of three $50 LL Bean gift cards. If you wish to
enter the raffle, enter your contact details as prompted and press "submit". If you don't wish to enter, then just exit out of the page. Thank you again for your participation!

End of Block: Demographics
APPENDIX C: CONSENT FORM

Dear Maine resident,

You are invited to participate in a research project conducted by Sarah Rappaport, a Master’s student in Ecology and Environmental Sciences at the University of Maine, and Dr. Sandra De Urioste-Stone, an assistant professor at the University of Maine. The purpose of this study is to better understand what Maine residents know about ticks and tick-borne diseases. Because each participant will represent many others who will not be studied, your input is incredibly valuable. You must be at least 18 years of age to participate in.

What will you be asked to do?
If you decide to participate, you will be asked to fill out the following online questionnaire, which will take approximately 20 minutes to complete.

Risks
There are no risks associated with this study. All we ask is for some of your time.

Benefits
While this study may have no direct benefit to you, this research will help us learn more about what Maine residents understand and know about ticks and tick-borne diseases. This information will be useful in long-term planning and to inform better communication about diseases.

Compensation
Upon completion of the survey, you will have the opportunity to enter your name into a raffle to win one of three $50 L.L. Bean gift cards. Winners will be notified once the survey period has concluded, after October 31st, 2020.

Confidentiality
Your responses to the survey will be entirely confidential. A key will be used to keep track of who has responded to the survey so that reminders are not sent unnecessarily. Please do not enter your name anywhere on the survey.

Voluntary
Your response is voluntary. You may stop the survey at any time or skip questions. Starting the survey implies consent to participate.

Contact Information
If you have any questions about this study, please contact:

Dr. Sandra De Urioste-Stone
Associate Professor, School of Forest Resources
University of Maine
(207) 581-2885
sandra.de@maine.edu
Or
Sarah Rappaport
M.S. Student, Ecology and Environmental Sciences
University of Maine
sarah.rappaport@maine.edu

If you have any questions about your rights as a research participant, please contact the Office of Research Compliance, University of Maine, 207/581-1498 or 207/581-2657 (or email umric@maine.edu)

Thank you for taking the time to complete this questionnaire!
APPENDIX D: INVITATION TO PARTICIPATE IN RESEARCH

Dear Maine resident,

You are invited to participate in a research project conducted by Sarah Rappaport, a Master’s student in Ecology and Environmental Sciences at the University of Maine, and Dr. Sandra De Urioste-Stone, an associate professor at the University of Maine. The purpose of this study is to better understand what Maine residents know about ticks and tick-borne diseases. Because each participant will represent many others who will not be studied, your input is extremely valuable.

To complete the survey please go to the following website:

Surveylink:  
Access code:

Upon completion of the survey you may enter to win one of three $50 gift cards from L.L. Bean. We will notify the winners once the survey period has concluded.

Your opinions are important to us. We look forward to your responses.

(signatures)

Dr. Sandra De Urioste-Stone  
Associate Professor  
sandra.de@maine.edu  
207-581-2885

Sarah Rappaport  
Master’s Student  
sarah.rappaport@maine.edu
Dear Maine resident,

Recently, we sent you an invitation to participate in our important study about ticks and tick-borne diseases. To our knowledge, we have not yet received your responses. We hope that you will take this opportunity to respond to our survey so that we may better understand your perceptions regarding tick-borne diseases in Maine. Your address is one of only a small number that have been randomly selected to help in this study.

We are writing again because of the importance that your household’s responses have for helping to get accurate results. Your participation is voluntary and your responses will be confidential. We would like to remind you that your input is valuable and very much appreciated. To complete the survey please go to the following website:

Survey link:
Access code:

Upon completion of the survey you may enter to win one of three $50 gift cards from L.L. Bean. We will notify the winners once the survey period has concluded.

Once again, your opinions are essential and important to us. We look forward to hearing from you.

Dr. Sandra De Urioste-Stone
Associate Professor, School of Forest Resources
University of Maine
(207) 581-2885
sandra.de@maine.edu

Sarah Rappaport
M.S. Student, Ecology and Environmental Sciences
University of Maine
sarah.rappaport@maine.edu
APPENDIX F: RAFFLE PAGE

Dear Maine resident,

Thank you for taking the time to complete this survey. On this page, you may enter your information to win one of three LL Bean gift cards, valued at $50 each. As a reminder, your contact information is not linked to the answers on the survey. That information is completely confidential.

Enter your contact information here:

Name:  
Email:  

Once we have received all of the survey results, we will notify you if you are a raffle winner. Thank you for your time and participation!

Dr. Sandra De Urioste-Stone  
Associate Professor, School of Forest Resources  
University of Maine  
(207) 581-2885  
sandra.de@maine.edu

Sarah Rappaport  
M.S. Student, Ecology and Environmental Sciences  
University of Maine  
sarah.rappaport@maine.edu
APPENDIX G: IRB APPROVAL FORM

APPLICATION COVER PAGE

- KEEP THIS PAGE AS ONE PAGE - DO NOT CHANGE MARGINS/FONTS!!!!!!!!!
- PLEASE SUBMIT THIS PAGE AS WORD DOCUMENT

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board, 400 Corbett Hall

(Type inside gray areas)

PRINCIPAL INVESTIGATOR: Sarah Rappaport EMAIL: sarah.rappaport@maine.edu
CO-INVESTIGATOR: EMAIL:
FACULTY SPONSOR: Dr. Sandra De Urioste-Stone EMAIL: Sandra.de@maine.edu

(TITLE OF PROJECT: Risk Perceptions of Tick-Borne Diseases in Maine
START DATE: 08/15/2020 PI DEPARTMENT: EES

STATUS OF PI: FACULTY/STAFF/GRADUATE/UNDERGRADUATE: Graduate student (F,S,G,U)

If PI is a student, is this research to be performed:

☐ for an honors thesis/senior thesis/capstone?  ☐ for a master’s thesis?
☐ for a doctoral dissertation?  ☐ for a course project?
☐ other (specify)

Submitting the application indicates the principal investigator’s agreement to abide by the responsibilities outlined in Section I.E. of the Policies and Procedures for the Protection of Human Subjects.

Faculty Sponsors are responsible for oversight of research conducted by their students. The Faculty Sponsor ensures that he/she has read the application and that the conduct of such research will be in accordance with the University of Maine’s Policies and Procedures for the Protection of Human Subjects of Research. REMINDER: if the principal investigator is an undergraduate student, the Faculty Sponsor MUST submit the application to the IRB.

Email this cover page and complete application to UMRIC@maine.edu

******************************************************************************
FOR IRB USE ONLY Application # 2020-07-04 Review (F/E): E Expedited Category:
ACTION TAKEN:
☐ Judged Exempt; category 2 Modifications required? Yes Accepted (date) 7/22/2020
☐ Approved as submitted. Date of next review: by Degree of Risk:
☐ Approved pending modifications. Date of next review: by Degree of Risk:
☐ Modifications accepted (date):
☐ Not approved (see attached statement)
☐ Judged not research with human subjects

FINAL APPROVAL TO BEGIN Date 10/2018

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BIOGRAPHY OF THE AUTHOR

Sarah Rappaport was born and raised in New Jersey, although she has continuously fled that state on many occasions. She attended Tulane University in New Orleans and graduated with a Bachelor’s degree in Environmental Studies in 2015. Later, Sarah moved to Massachusetts to complete a Master’s degree in Journalism from Boston University in 2018. Sarah is a candidate for the Master of Science degree in Ecology and Environmental Sciences from the University of Maine in August 2021. She will be joining the veterinary staff at Maine Veterinary Medical Center as an Emergency Medicine Clinical Liaison and coordinator in order to become more integrated in the world of One Health. Sarah is a candidate for the Master of Science degree in Ecology and Environmental Sciences from the University of Maine in August 2021.