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Risk Perceptions of Tick-borne Diseases in Maine

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RISK PERCEPTIONS OF TICK-BORNE DISEASES IN MAINE

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Tick-borne diseases have been a rising threat to public health. Maine is experiencing a continued north and westward migration of Lyme disease into the state and increasing numbers of cases year after year (Rosenberg et al., 2018). Maine's economy has a high reliance on the tourism industry, with a focus on outdoor recreation (Maine Office of Tourism, 2018), and the future success of this sector may be threatened by the risk that Lyme disease poses. One's perception of risk is known to be influenced by the information available around them (Kasperson et al., 1988). Thus, it is pertinent that we broaden our knowledge of the information being presented in newsprint media in the state of Maine. The overall goal of this research is to expand our understanding of the risk perceptions that visitors to Acadia National Park hold regarding ticks and tick-borne diseases.

Acadia National Park is a key tourism destination in the state of Maine with over 4 million visitors on average every year, making it the fifth most visited national park in 2022 (National Park Service, 2023). Besides people, black legged (deer) ticks are also present in the park and there is an increasing public health concern, with increasing Lyme disease cases in Maine. This study couples visitor perceptions of ticks and tick-borne disease, as well as resulting behavioral implications, with information provided in newsprint media. Visitation to Acadia National Park has the potential to be impacted by the behavioral intentions studied.

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LIST OF ABBREVIATIONS

ANP: Acadia National Park

CDC: Centers for Disease Control and Prevention

MDI: Mount Desert Island

MMCRI: Maine Medical Center Research Institute

PPB: Personal prevention behaviors

SARF: Social Amplification of Risk Framework

TBD: Tick-borne disease

CHAPTER 1: INTRODUCTION

1.1 Lyme and other TBD Disease

Tick-borne diseases are a major topic of concern in the state of Maine and throughout the United States. The Centers for Disease Control and Prevention (CDC), states that the number of reported cases of tickborne disease (TBD) has more than doubled over the past 13 years (Rosenberg et al., 2018), increasing in not only incidence buts also geographic extent (Eisen et al., 2016). Of the 16 types of tick-borne diseases present in the country, Lyme disease alone attributes to 82% of all tick-borne diseases during 2004-2016 (Rosenberg, 2018), and is the most reported vector-borne disease with an estimation of 300,000 cases annually (Bacon et al., 2008; Fischhoff et al., 2019).

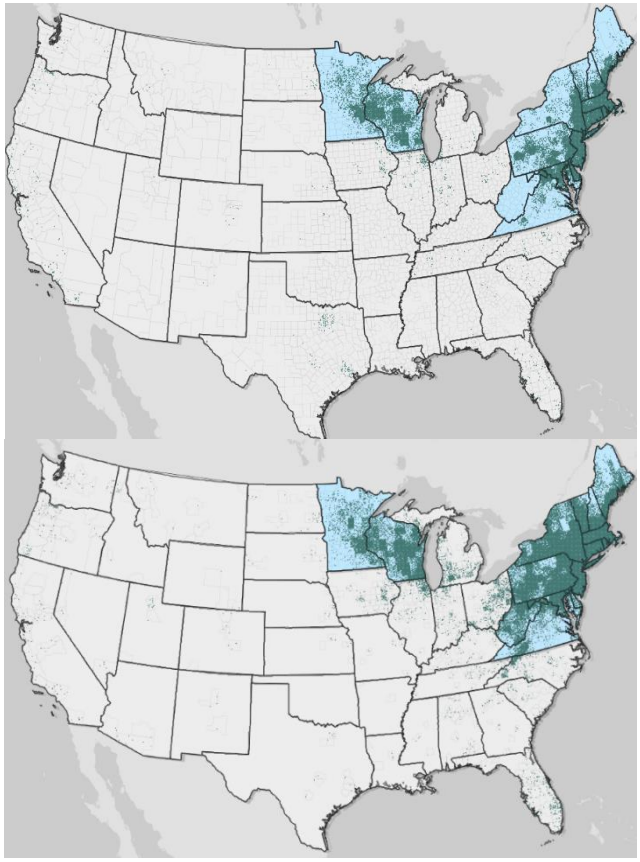

Figure 1. Reported Cases of Lyme Disease Incidence: 2010 (top) versus 2021 (bottom). Images from Centers for Disease

Maine has ranked third among all U.S. states during the period of 2008 through 2015 at 66.8 cases per 100,000 (Schwartz et al., 2017), ranking as the state with the highest TBD annual rate in 2021 (CDC, 2024). Figure 1 is a visual generated by the CDC which displays total Lyme disease case amounts and locations from 2010 and 2021 across the continental United States, as represented as one green dot for each individual case, placed randomly within the county of residence. The states shaded in blue indicate high incidence states for Lyme disease, with the states

shaded in gray indicating low incidence states, with the Northeast being home to many of these cases.

The black-legged tick (*Ixodes scapularis)*, also commonly referred to as the deer tick, is responsible for carrying the bacterial spirochete *Borrelia burgdorferi,* the cause of Lyme disease (Burgdorferi et al., 1982; Spielman et al., 1985). The spatial distribution of this tick and Lyme disease incidence is strongly correlated (Rand et al. 2007). The black-legged tick is also capable of carrying the four other diseases known to occur in Maine including anaplasmosis, babesiosis, *Borrelia miyamotoi disease*, and *Powassan* encephalitis. As the name states, the black-legged tick is most easily distinguished from other ticks common in Maine by the presence of their black legs, as compared to the brown legs of the American dog tick (*Dermacentor variabilis*) which is not known to carry diseases to humans in Maine (University of Maine Cooperative Extension, 2024).

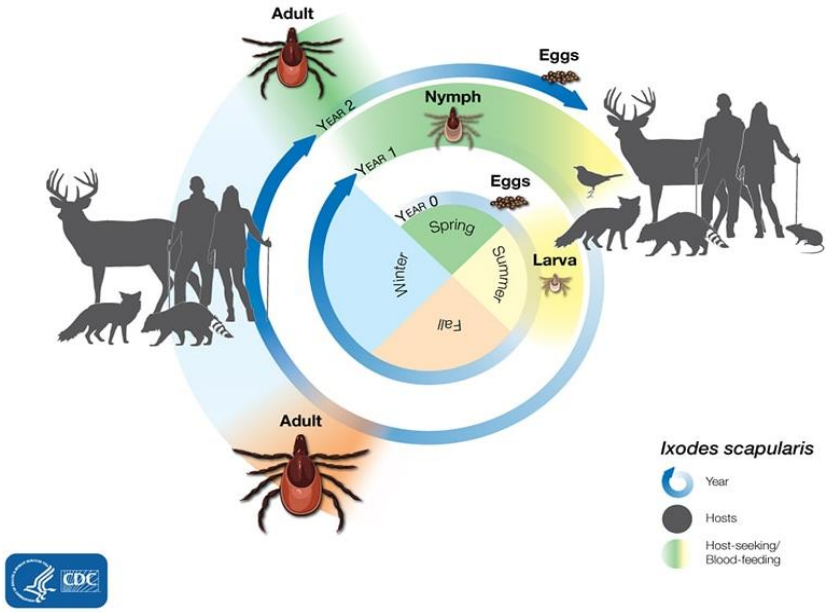

Figure 2. Life cycle of black-legged tick. Image from Centers for Disease Control and Prevention

I. scapularis has a two-year lifecycle and actively seeks a host (questing) during two of their life phases. In Maine, we see peaks in questing in June and July when the tick is in the nymphal phase, and peaks in late October into November when the tick is an adult (Elias, 2019).

In Eastern North America, the primary host for nymphal ticks are small mammals such as the white-footed mouse

(*Peromyscus leucopus*) and the eastern chipmunk (*Tamias striatus*) (Levi et al., 2016; Ostfeld et al., 2014). The abundance of white-tailed deer (*Odocoileus virginianus*) has also been found to correlate positively with the abundance of larval ticks the following year, leading to a two-year lagged correlation between deer and nymph densities (Barbour & Fish, 1993; Rand et al., 2004). However, this linear relationship only applies to low to moderate deer densities, with the relationship not applying to greater deer densities (Elias, 2019). Rather, increasing summer relative humidity may benefit *I. scapularis* (Elias, 2020), as tick survival rates are positively correlated with humidity (Bertrand & Wilson, 1997; Eisen, 2002; Yuval & Spielman, 1990).

1.1.1 Objective Risk

When infected with the bacteria *Borrelia burgdorferi*, this tick in both the nymphal and adult stages can transmit Lyme disease to their host if attached and feeding for at least 24 hours (Jones, 2015). 70-80% of infected individuals will experience a skin rash called erythema migraines, which is a rash that is larger than two inches in diameter that may appear between the period of two days to three weeks following the tick bite (Elias et al., 2020; Steere et al., 1977; Steere 2003). As the rash expands, paler bands may appear, developing a “target” or “bull’s-eye” appearance (CDC, 2022). Other satellite rashes may appear on other parts of the body on occasion.

With or without the development of rashes, other early, localized symptoms include headache, fatigue, chills, fever, as well as myalgia, arthralgia, and malaise (CDC 2022). Furthering the risk posed to humans, Lyme can be particularly challenging to diagnose (CDC, 1995; Paules et al. 2018). If Lyme goes unnoticed or untreated, then the disease will take days to months to progress for about 60% of patients, with complications including neurologic, cardiac, and rheumatological manifestations, with the latter known to be particularly delayed after initial infection (CDC, 2022; Lantos et al. 2021; Sanchez et al., 2016).

1.1.1 Personal Protective Behavior

Reducing the potential impacts of tick-borne diseases is of paramount importance in areas such as Maine, Acadia National Park (ANP) specifically, and a plethora of other natural areas throughout the northeast. With no human vaccines currently available, individuals can take steps to prevent Lyme disease by reducing their likelihood for experiencing a tick bite (Donohue et al., 2015; Piesman & Eisen, 2008), and by performing personal protective behaviors (PPB).

Tick checks, applying insect repellent, wearing long protective clothing such as long sleeves and long pants, and tucking pants into socks are among the most common suggestions put forth by the CDC and in the literature (CDC, 2019; Lantos et al., 2021). To be most effective, protective behaviors should be performed consistently for the entirety of the Lyme disease transmission season (Corapi et al., 2007).

Wearing light colored clothing can help one spot a tick with greater ease and wearing clothing that covers the body, as well as tucking pant legs into socks can help to diminish exposure (Hayes & Piesman, 2003; CDC, 2021). Insect repellents can also be used on clothing and gear, particularly those that contain DEET (diethyltoluamide) and permethrin (Clark & Hu, 2008). Additional recommendations from the CDC include remaining in the center of trails and avoiding areas of high grass and leaf litter, as well as checking clothes, gear, and pets for the presence of ticks. Showering within two hours of returning indoors after outdoor exposure has also been shown to reduce the risk of Lyme disease (CDC, 2021).

However, even with prevention behaviors available, low levels of behavioral adoption are being reported (e.g. Aenishaenslin et al., 2022; Vázquez et al., 2008). While investigating the results of annual, nationally representative surveys of the U.S. public's experience with TBDs, Hook et al. (2015) found that tick checks were the most reported personal preventative practice

with (42%) of participants engaging in this activity in New England regions, consistent with findings from others (Butler et al., 2016; Omodior et al., 2015; Valente et al., 2015). However, roughly half, or more of the participants in many of these studies fail to participate in any personal prevention (Aenishaenslin et al., 2017; Hook et al., 2015), even with awareness and heightened levels of perceived risk (Aenishaenslin et al., 2017).

These results tie back to Fischoff (1995) where it was challenged that these statements: "all we have to do tell them the numbers" and "all we have to do is to show them that it's a good deal for them," are not enough to drive the communication strategy when informing the public (pg. 138). It has been found that even with education of TBD, preventive behaviors are not always taken, with no significant difference found between education and the practice of performing preventative behaviors (Shadick et al., 1997; Valente et al., 2015).

Efficacy may be a modifying factor in play with the relationship with risk perception and adoption of personal protective behaviors. Self-efficacy is one's belief of whether they possess the necessary knowledge, skills, or resources to perform a specific behavior (Ajzen, 1991), how much effort will be expended, and if the behavior will be sustained (Bandura, 1977).

During a study conducted in New Zealand that investigated the relationship between knowledge and perceived efficacy of global warming and climate change, concern was found to mediate these variables, with knowledge increasing concern which in turn increases perceived efficacy and personal responsibility for solutions (Milfont, 2012). The almost stark opposite was found in the United States, with individuals with higher levels of information of global warming showing less concern, resulting in a negative relationship between knowledge and perceived risk (Kellstedt et al., 2008).

Shadick et al.'s study investigated self-efficacy surrounding TBD and found significant results that determinants of tick avoidance behavior included having confidence in recognizing Lyme symptoms, belief that Lyme disease is a serious illness, belief that the benefits of the behaviors outweigh the inconveniences, and that avoidance is effective in reducing the risk (1997). Further, those with confidence that they could find a tick on themselves served as a predictor for performance of avoidance behavior. In another study, perceived efficacy was found to be the strongest factor associated with the adoption of the three common preventative behavioral actions of tick check, protective clothing, and application of tick repellent in a study performed in an area endemic for Lyme in Switzerland and where the disease is currently emerging in Canada (Aenishaenslin et al., 2015).

1.2. Tourism in Maine

In 2022, Maine hosted over 15 million visitors, with tourists spending more than $8.6 billion in the state (Maine Office of Tourism, 2023b). Tourism supported 15,100 jobs and contributed to nearly $5.6 billion in earnings to Maine's households, with every 102 visitors supporting a new job in the state. This visitation included nearly 3.4 million day-visitors in 2022, with an additional 12 million in overnight visitors, where 78% of visitors stayed one or more nights in the state on their trip. In the same year, outdoor recreation made up 3.9% of Maine's economy, with over 32,000 people working in outdoor industry in Maine, ranking Maine as the state with the sixth highest value added in the country (Bureau of Economic Analysis, 2023a; 2023b).

Figure 3. Map of Tourism Regions in Maine. Image from Maine Tourism (2020).

The state is broken into eight tourism regions, illustrated here in Figure 3. These regions include the Maine Beaches, Greater Portland and Casco Bay, Mid-Coast, the Maine Lakes and Mountains, Kennebec and Moose River Valley, Downeast and Acadia, Aroostook County, as well as the Maine Highlands region.

1.2.1 Downeast and ACAD Tourism Region

25% of all visitors to Maine in 2022 reported visiting the Downeast & Acadia tourism region (Maine Office of Tourism, 2023a). In 2023, visitors to the region spent $1.2 billion, with tourism supporting 15,300 jobs and contributing $607 hundred thousand in total wages supported. In addition, every 133 visitors supported a new job in the region, and visitors saved every household in this region $4,407 in state and local taxes (Maine Office of Tourism, 2024).

Compared to visitors to other regions in the state, visitors to Downeast & Acadia region were more likely to participate in sightseeing and touring, active outdoor activities, and nature and birdwatching in 2021 (Maine Office of Tourism, 2022). In 2020, 61% of visitors to this region participated in hiking, climbing, or backpacking, and in the following year, 59% of visitors participated in active outdoor activities, with 13% claiming this as their primary activity (Maine Office of Tourism 2021; 2022). Further, this region has the third highest number of commercial campgrounds in the state with 25 campgrounds available (Maine SCORP, 2019).

1.3 Risk Perception

To understand the impact of the increasing cases of Lyme disease on the outdoor recreation-tourism heavy atmosphere that is the state of Maine, it is essential that we can also understand how the risk of TBD is perceived by the public. Risk can broadly be defined by the possibility of loss (Taylor, 1974), a measurement of the technical amount of risk (Fischoff, 1995) but more specifically, risk focuses on both the probability of events, as well as the magnitude of the correlating consequences (Kasperson et al., 1988). Experts judge risk with technical estimates such as annual fatality rates that tend not to be influenced by outside factors such as catastrophic potential and the threat imposed to future generations (Slovic, 1987), while on the contrary, risk as understood by laypeople and referred as risk perception hereafter, is sensitive to factors that in turn, impact individuals' judgements (Rowan, 1991; Sandman, 1987; 1993).

This concept of perceived risk was first introduced to marketing literature (Bauer, 1960), then to the field of psychology (Kogan & Wallach, 1964), where risk taking was primarily discussed. An adapted version that came about later stems from consumer researchers where risk perception is viewed as the uncertainty along with the adverse consequences involved with buying a product or service (Dowling & Staelin, 1994), or more specifically, when a tourist is purchasing a group tour package and has to decide whether or not to engage in an outdoor recreation activity that requires time and money investment, but the degree of risk is not known, and therefore a risk decision has to be conducted in a 'fuzzy' environment (Sheng-Hshiung et al., 1997). This serves as an example where an individual's perceived risk is far from the objective risk (Boholm, 1996).

The opposite can also exist, where the perceived risk that an individual holds can be closely aligned with the objective or actual risk, particularly when there is a full understanding of the risk (Sjöberg, 1997). The varying ways in which researchers chose to define risk perception can be

attributed to the highly interdisciplinary nature of the concept itself (Bodemer & Gaissmaier, 2015), which leads it to require a multidimensional approach (Wilson et al., 2019).

Risk perception is a multifaced variable that is a result of the differentiation between actual threats and a subjective discernment of the experience of those threats (Kasperson et al., 2003), one that cannot exist independent of individuals perceptions to environmental risk. Individuals risk perceptions have been shown to be significantly altered by cognitive factors such as general knowledge of a hazard (Pidgeon, 2012).

1.3.1 Knowledge

The line of thinking may exist that a lack of knowledge could be attributed to a lack of awareness or support for an issue affecting the public, ergo limiting the public risk perceptions. The knowledge deficit model of science communication was proposed to explore the concept of science literacy in the 1980s which found most adults in the United States to be scientifically illiterate (Miller, 1983), calling for increased science and technology communication for public audiences. However, this has long been a debated theory (e.g. Feinstein, 2010) and cause for a fundamental reconsideration, leading to alternative approaches. However, this model continues to persist due in part to its simplicity and allure of its narrow focus of the potential impact of simply addressing public knowledge levels (Simis et al., 2016). Due to the current understanding of the complex nature of risk perception being compromised of factors outside of simply knowledge, it is essential to acknowledge the role of public knowledge but also the interaction between other outside variables.

The amount of knowledge that one possesses has been shown to correlate with individuals risk perceptions (Helgeson et al., 2012; van der Linden, 2015). However, overall knowledge does not always translate to correlating strongly with risk-reducing behavioral changes, despite the

presence of a high risk (Shadick et al., 1997; Valente et al., 2015). Kellstedt et al., (2008) even found a negative association with risk perception and knowledge regarding climate change, where the more information one receives about global warming, the less concerned they are for it. Kaiser and Fuhrer (2003) further noted that there is a difference between self-reported knowledge and actual knowledge of risk, and that knowledge without mediators does not necessarily lead to corresponding behavior.

Risk of Lyme is magnified when there is a lack of awareness of the risks, unfamiliarity with infection signs and symptoms, low performance levels of mitigation practices, and when there is uncertainty over where to seek information or support (Daltroy et al., 2007; Donohue et al., 2015). A study conducted in an endemic area of Massachusetts found that participants educated in tick-borne illnesses were significantly more likely to use personal prevention tactics (e.g. use repellent and perform tick checks) and presented lower rates of tick-borne illnesses than those receiving an education unrelated to TBD (Daltroy et al., 2007). It is speculated that more knowledge of Lyme disease is available and is more developed in areas where TBD are endemic (Herrington et al., 1997; Donohue et al., 2015).

Milfont (2012) investigated the interplay between knowledge, perceived efficacy, and concern about global warming and climate change in a one-year longitudinal study and found that greater knowledge was positively associated with higher concern and willingness to act, further supporting existing literature on this relationship (Grob, 1995; Kaiser & Fuher, 2003; Meinhold & Malkus, 2005) and showed a positive effect of information level on perceived efficacy, contradicting the level correlation showed in Kellstedt el al.,'s study (2008) where respondents with higher levels of knowledge of global warming showed less concern about the issue. However, this study notes that their results may be due in part to their study matter at hand. Their results also

show that for their case for global warming, participants with increased levels of information displayed decreased levels of perceived efficacy, speculated that individuals are pessimistic about their ability to play a role in the multifaceted issue.

Knowledge in itself is a complex variable (Charles et al., 2013) and alone it can be unlikely to be sufficient to cause a change in behavior sustainably (Milfont, 2012). The role that knowledge plays on risk perception has been shown to be variable across a variety of studies. A positive correlation was found between using a tick identification manual and the successful identification of engorged ticks, with the correct identification increasing six-fold (Butler et al., 2017). However, in a study of residents of Connecticut USA, an area highly endemic for Lyme disease, the participants that reported being knowledgeable of Lyme disease believed that they had a high probability of contracting Lyme disease and had mixed effects on the influence on the continuation of personal protective behaviors (Gould et al., 2008).

Kaiser and Fuher (2003) argued that the influence of knowledge toward ecological behavior has been historically underestimated by failing to assess more than one or two forms of knowledge, and this may help to explain the disparities mentioned above of the role that knowledge plays into one's perceived risk and participation in personal preventative behavior, where most studies fail to differentiate between self-reported knowledge and actual knowledge (Bayles et al., 2013; Butler et al., 2016; Beaujean et al., 2013; Gould et al., 2008; Kellstedt et al., 2008). Kaiser and Fuher instead provided three forms of knowledge, declarative, procedural, and effectiveness knowledge, with an additional attribute of social knowledge, emphasizing that it is the convergence of these that must be measured when trying to predict ecological behavior.

Van der Linden (2015) also aimed to provide a more reliable assessment of knowledge by breaking the cognitive factor of knowledge (Sundblad et al., 2009) into three categories, causal

knowledge, the knowledge that an individual possess on if a potential hazard is a basis of risk, impact knowledge, if a potential hazard would have an impact on the amount of risk, and response knowledge, to what degree a behavior can change the level of risk if implemented.

1.3.2 Trust

Trust is known to be another vital factor that influences risk perception (Freudenburg, 1993), and distrust can be just as impactful (Slovic, 1993; Tuler & Kasperson, 2013). A survey of an original and representative sample of Americans performed by Kellstedt et al., (2008) found that the three driving forces for risk perceptions, in this case pertaining to climate change, were informedness, confidence in scientists (trust), and personal efficacy. Siegrist & Cvetkovich (2000) preformed a study where they issued a questionnaire to participants enrolled in an introductory psychological course at Western Washington University, looking at individuals' judgements of risk, perceived benefits, trust, and knowledge. Their results suggested that the lay public relies on social trust in the absence of sufficient knowledge on an issue, while no significant correlations were identified for people who were knowledgeable. This puts significant weight on the amplification stations, which can serve as information sources for lay individuals (Kasperson et al., 1988) who do not have sufficient pre-existing knowledge of a risk. News media is one example of an amplification station, and the content will be further explored in Chapter 2.

The degree to which information is disputed by either individuals or groups may also influence the impact of risk communication. The use of opposing views in hopes to achieve balance, despite accuracy or numeracy of those views, can distort the impact of the message (Dixon & Clarke, 2013; Priest et al., 2015). When experts debate a risk, public uncertainty and doubts can be heighted and the credibility of information may be questioned (Mazur, 1984).

Communication research has suggested salient value similarity (SVS) as a measurement of trust (Clarke, 2009). When an individual holds little knowledge of a risk, then they may simplify trust judgements to compare their personal values with the values of the entity making the suggestions (Earle & Cvetkovich, 1994).

1.3.3 Efficacy

Personal-efficacy, or self-efficacy can be understood to be the expectancy about one's own competence to perform the behavior necessary to produce the desired outcome (Rosenstock et al., 1988). A cross-sectional analysis of residents from Martha's Vineyard Island in Massachusetts found interesting results of what motivated behaviors with regards to TBD preventative behaviors. Increased knowledge about Lyme disease symptoms and the available preventative behavior present were not associated with less risky behavior (Shadick et al., 1997). Instead, having a sense of confidence (self-efficacy) in one's ability to find a tick on oneself, as well as having a personal acquaintance with Lyme disease (experience with TBD) were important determinants of individual actions. The most influential sources of efficacy information have been found to be performance accomplishments, with vicarious experience (experience gained through observation) being the second most potent form of self-efficacy (Rosenstock et al., 1988). An additional study of two places in Canada, one endemic for Lyme and another where the disease is emerging, found perceived efficacy to be the strongest factor associated with the implementation of preventative behaviors, specifically tick check, wearing of protective clothing, and application of tick repellent (Aenishaenslin et al., 2015).

Much like knowledge, perceived efficacy has been found to be a complex variable with varying results. High levels of self-efficacy have been found to correlate with the performance of preventive behavior (Butler et al., 2016) with increased information of symptoms and personal

protection assumed to increase self-efficacy (Roche & Muskavitch, 2003). In other cases, increased informedness can yield a negative effect of levels of personal efficacy (Kellstedt et al. 2008).

Further, messages of self-efficacy are not always present with risk messages. A study conducted on print media in North America surrounding the emergence of West Nile virus, another vector-borne disease, found that the most articles failed to provide risk-reduction tactics, similar to Rossow and Dunwoody (1991) where only a quarter of the articles investigated provided the public messages of efficacy in a nuclear waste controversy. These studies are not alone, as many other content analyses also find remarkably low levels of self-efficacy messages provided (Dudo, 2007; Roche & Muskavitch, 2003). However, it is widely accepted that implementation of preventative actions to reduce the risk of infection can be improved through messages of self-efficacy (Dahlstrom et al., 2012; Dryhurst et al., 2020; Vos et al., 2018).

1.3.4 Personal Experience

Following hazard experiences such as epidemics and natural disasters, there can be a flurry of interest in prevention (Weinstein, 1989). However, personal experience has been largely believed to play a role in the recognition of risk and the motivation to take precautions (Kasperson et al., 1988; Weinstein, 1989). Experience of a risk can also be viewed as one's familiarity with the risk which can lower perceptions of riskiness (Fischoff et al., 1978). This can be through daily exposure without adverse effects, which ties into Weinstein's (1989) findings further discussed below, where most hurricanes that were experienced were by those on the edge of the storm, where risk perception was lowered after the individual gained experience with the hazard. Kasperson et al., (1988) also provide the example of the act of driving as a risk reduction because of the number of times one can successfully perform the task without adverse effects, potentially due to the direct

experience providing the individual with feedback on the nature, extent, and potential manageability of the hazard (Slovic, 1986).

Weinstein extensively reviewed a variety of studies involving events and their implications on behavior such as automobile accidents on seat belt use and natural hazards on both natural hazard preparedness and compliance with evacuation warnings (1989). The intraindividual effects of personal experience of this review included two that tended to increase the personal perception of risk; personal experience often leading individuals to see hazards as more probable and the ability to view themselves as future victims, and the second outcome of experience causing people to think about the risk more regularly and with increased clarity. However, the duration of the increased risk perception and likelihood to engage in preventative behavior can be short. The type of experience also impacted the risk perception, with the seriousness and controllability of their experience playing a specific role only on similar situations to be encountered, including individuals taking the precautionary behaviors that they perceived as appropriate for their past encounter with the risk, regardless of the current circumstances.

When direct personal experience is lacking, we rely on indirect experience to make decisions about a risk (Kasperson et al., 1988). Media exposure plays a substantial role in this form of experience, and message content and volume can serve as risk amplifiers or attenuators to how risk is experienced. The study presented in Chapter 2 will focus on a content analysis of newsprint media where information about the risk of TBD is made accessible to the public. Further, Chapter 3 will explore the relationship of experience with TBD with factors such as risk perception and personal preventative behaviors.

The case of experience causing attenuation may be attributed to one becoming familiar with the risk event due to frequency of exposure (Fischhoff et al., 1978) or through risk

comparisons (Fischhoff et al., 1995) both of which can lower the risk perception, and aid in the explanation of the mixed role that experience plays in an individual's risk reduction actions. Further, Weinstein urges experience to be measured through a variety of factors, including severity of experience, degree of damage or harm, and time since the risk occurred (1989).

Experience with ticks comes in a variety of forms and the impact that the experience has on one's behavior varies. Personal experience with previous tick bites has been found to be a significant predicator of the action of checking skin for the presence of ticks (Beaujean et al., 2013; Van der Heijden et al., 2017; Valente et al., 2015) and associated, but not a significant determinant in preventative behavior actions (Aenishaenslin et al., 2017). On the contrary, the experience of personally having Lyme disease was not significancy related to either performing avoidance behaviors or performing a tick check (Shadick et al., 1997). Further investigation is needed to determine the role of simply knowing someone with Lyme disease or other TBD, as experience has continued to yield mixed results.

1.3.5 Socio-demographics

Socio-cultural factors have been known to contribute to risk perceptions, such as political affiliations, education, gender, and age (Finucane et al., 2000; van der Linden, 2014). The term white male effect (WME) (Finucane et al., 2000) was introduced to describe the occurrence that white males tend to have risk perceptions that are much lower as opposed to others in demographic groups different than their own. Numerous studies find support for these trends between genders, with women finding risk with regards to health and safety to be more problematic than their counterparts (Flynn et al., 1994; Slovic, 1987). Finucane's survey data further revealed that the white males in their study tend to display less fatalistic and egalitarian views, but rather increased hierarchical and individualistic views. Other findings from this work included that white males

seemed more trusting in technological hazards and less trusting of the government, particularly holding distrust to the federal government from managing risks surrounding technology.

When applying the WME to Sweden, Olofsson & Rashid, (2011) failed to find a significant difference between men and women, seemingly disproving the WME in places outside of the US, but rather found that individuals with a foreign backgrounds tended to perceive a greater risk than native-borne, leading them to suggest that WME might not be the best description of this occurrence, and suggested the use of the term 'societal inequity effect' (p. 1030), but did call for additional research to investigate this hypothesis.

In Maine, case counts between genders tend to be relatively equal with (45%) of Lyme cases were female and (55%) were male in 2021 with consistent results in 2022 as well with (43%) of Lyme cases female and (57%) male (Maine CDC, 2022; Maine CDC, 2023). In some studies, gender has not been found to be significantly associated with performing a tick check (Beaujean et al., 2013; Van der Heijden et al., 2017), or wearing protective clothing (Beaujean et al., 2013), but was found to be a significant cofounder to participant's proximal goal for performing a tick check (Van der Heijden et al., 2017). Contrary, in a region in Switzerland endemic for Lyme disease, men were significantly less likely to perform a tick check after outdoor activities and in a region of Canada with an emerging risk of Lyme, men were significantly less likely to avoid wooded areas during high-risk periods (Aenishaenslin et al., 2015).

The age of those contracting Lyme within the state however does show disparity between age groups. Age at diagnosis did have a large range from 1-97 and 1-100 in 2021 and 2022 respectively with the median age of 58 and average of 51 in 2021, (Maine CDC, 2022; Maine CDC, 2023, see also Figure 5) The age groups with the highest number of submissions of tick testing within the state came from children under the age of 15 and adults over the age of 45. Those between the

ages of 15 and 24 were consistently found to be the age group with the fewest submissions of blacklegged ticks. (University of Maine Cooperative Extension, 2024).

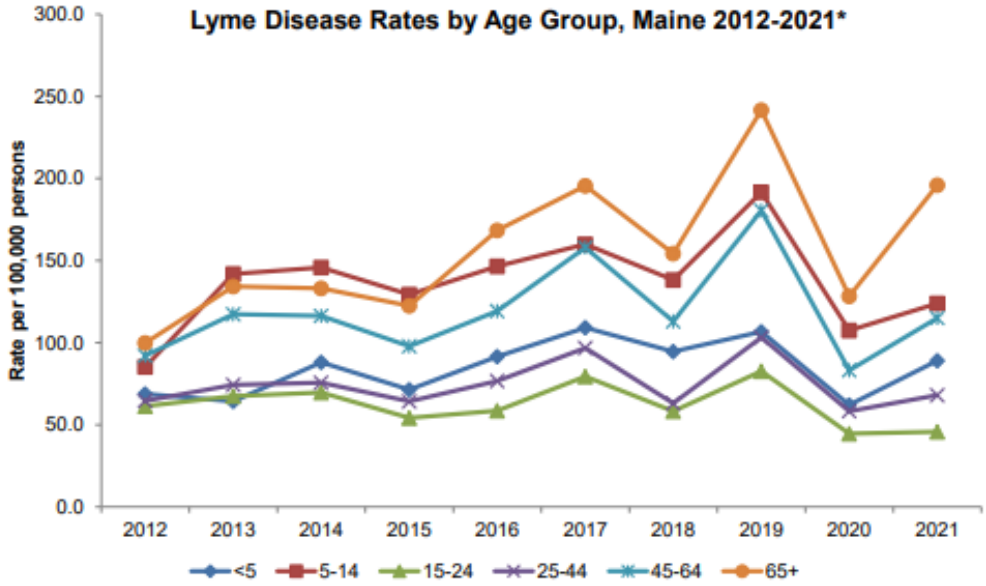

Figure 4. Percent of cases of Lyme disease by age group. Image from Maine CDC.

Age has been found to be associated with participation with preventative behavior. Those aged 55 and older have been found to avoid wooded areas during high-risk periods and treat their property with acaricides at a statistically higher rate than their younger counterparts, with those aged 18-34 applying repellent significantly more than older age groups (Aenishaenslin et al., 2015). In a study conducted on Martha's Vineyard Island, Massachusetts, those 51 to 75 years of age were found to be significantly more likely to participate in tick checks than adolescents (47% vs 30%), as well as limit time outdoors (28% vs 10%) (Valente et al., 2015). This supports earlier work where age was a significant factor in the performance of avoidance behaviors, with younger respondents performing fewer avoidance behaviors (Shadick et al., 1997). On the contrary, in a study of those with Lyme disease, a statistically significant difference was not found with use of protective measures and age-matched controls (Orloski et al., 1988).

1.4 Research Justification/Rationale and Significance

Lyme disease has posed itself as a public health crisis in Maine and is only expected to get worse in the upcoming years (Eisen & Eisen, 2018; Rand et al., 2004; Smith et al., 2019). Risks such as disease outbreaks have been suggested to have direct implication of visitors' experiences (De-Urioste-Stone et al. 2016; Huebner 2012). With the high reliance on tourism, with a focus on outdoor recreation, it is essential to increase our understanding of visitors' risk perceptions on the issue of tick-borne diseases in the state. This will be crucial in increasing our understanding of the current and future state of the outdoor recreation tourism industry, particularly in the tourism hot spot that is Acadia National Park.

1.5 Organization of Thesis

Chapter 2 presents a content analysis of newsprint media released in Maine about TBD. The study explored the content and frequency of messages, focusing on those elevating or minimizing the risk, as well as guidance messages. Specific codes included investigating messages such as *you can get Lyme disease from a black-legged tick, infection can be prevented by wearing long, light colored clothes,* and *guidelines on how to treat the symptoms with modern medicine*. This study captured all unique newsprint media released in Maine between January 01, 2010, and December 31, 2021. This chapter investigated trends of what messages are being presented, the frequency of the messages across articles, as well as how their presence has or has not changed during the study period.

Chapter 3 discusses a mixed-mode survey of visitors to Acadia National Park conducted in 2019. The survey instrument included questions on visitors experience with TBD, perception of risk, personal preventative behaviors, socio-demographics, and resulting implications of TBD

concern. Specifically, statistical analyses such as Chi-Square and Cramer's V were used to explore the relationship between experience with TBD and the previously mentioned factors.

Chapter 4 serves as a conclusionary chapter to summarize the results from Chapters 2 and 3. This serves to put the knowledge of respondents to the ANP survey in context to the messages presented in the news media. Further, we specifically address visitors reported implications of their risk perceptions regarding potential implications for visitation in the park.

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CHAPTER 2: CONTENT ANALYSIS OF NEWS MEDIA IN MAINE, USA FROM 2010-2021

2.1 Introduction

Maine relies heavily on the nature-based tourism industry and outdoor recreation to power its economy. In 2021, Tourism supported 21% of employment in the state (Maine Office of Tourism, 2022a) and in 2022, 32,000 people were employed in the outdoor economy, making up 3.9% of Maine's Gross Domestic Product (GDP), sixth largest share of any state in the country (Maine Office of Tourism, 2024). However, these industries have the potential to be at risk from the rising threat of Lyme disease (Horne et al., 2022). With no current Lyme disease vaccine available (CDC, 2022a), and the risk of other TBD continuing to rise (Maine CDC, 2024), often the public is required to rely on their knowledge and willingness to participate with personal prevention measures to manage their level of risk (Beaujean et al., 2013; Valente, 2015).

News media plays a critical role in communicating information and educating the public on important issues (Witte, 1995; Dahlstrom et al., 2011). It is valuable to understand what risk-related messages are being provided during a public health emergency as this may affect the perceptions and possibly actions of those receiving the message. The information systems by which the public obtains information about risk and the way in which they respond shape their perception of risk through "social amplification of risk" (Kasperson et al. 1988). This can be influenced by various factors such as the volume of information (Sell et al., 2018). Specifically, information volume can increase the perception of how serious a message is by intensifying the message (Kasperson et al., 1988; Mazur, 1984; Renn, 1991).

In the case of the increase in Lyme disease cases in Maine, new challenges are posed when the symptoms experienced once infected with Lyme disease could be attributed to a plethora of

other sources, particularly when 20-30% of infected individuals do not experience a rash (Steere et al, 2003; Hatchette, 2014). This study aims to understand the content and frequency of messages in the news media in Maine, using a quantitative content analysis which serves as a standardized codebook to make statistical analysis possible (Metag, 2016), and will be the first to be conducted in the state regarding the messaging of tick-borne diseases to our knowledge.

2.2 Risk Communication

The Social Amplification of Risk Framework (SARF) was developed as a conceptual framework to assess the intersection of technical issues of risk with the psychological, sociological, and cultural perspectives of risk perception and risk-related behavior (Kasperson et al., 1988). SARF was proposed to provide the theoretical base necessary to address the complexity and transdisciplinary nature of risk perceptions, as well as to allow for a comprehensive analysis of risk (Kasperson et al., 1988; Kasperson et al., 2022). Further, this arose to address the instances where minor risks or risk events, as assessed by technical experts, would provoke strong public concerns. SARF draws heavily on communication theory, specifically on the topic of amplification which is the process of escalating or lessening signals following the transmission of information from the source to any intermediate transmitters, and then to the receiver (Kasperson et al., 1996).

The analogy of dropping a pebble into a pond is utilized to describe how the impacts associated with the social amplification of risk spread, first hitting the victims, and then spreading outward (Figure 5). Secondary experience, such as a friend or family member experiencing a risk, can also serve as information received about the risk, therefore playing a role in risk perception and may induce significant indirect costs (Slovic, 1987). The role of this form of experience will be further investigated in Chapter 3 with visitors to Acadia National Park.

Experience, however, does not automatically amplify a risk, it can also serve to attenuate, or reduce the perceived risk (Kasperson et al., 1988). Direct or indirect experience can provide insight into the nature, extent, and manageability of a particular hazard. As shown in Figure 5,

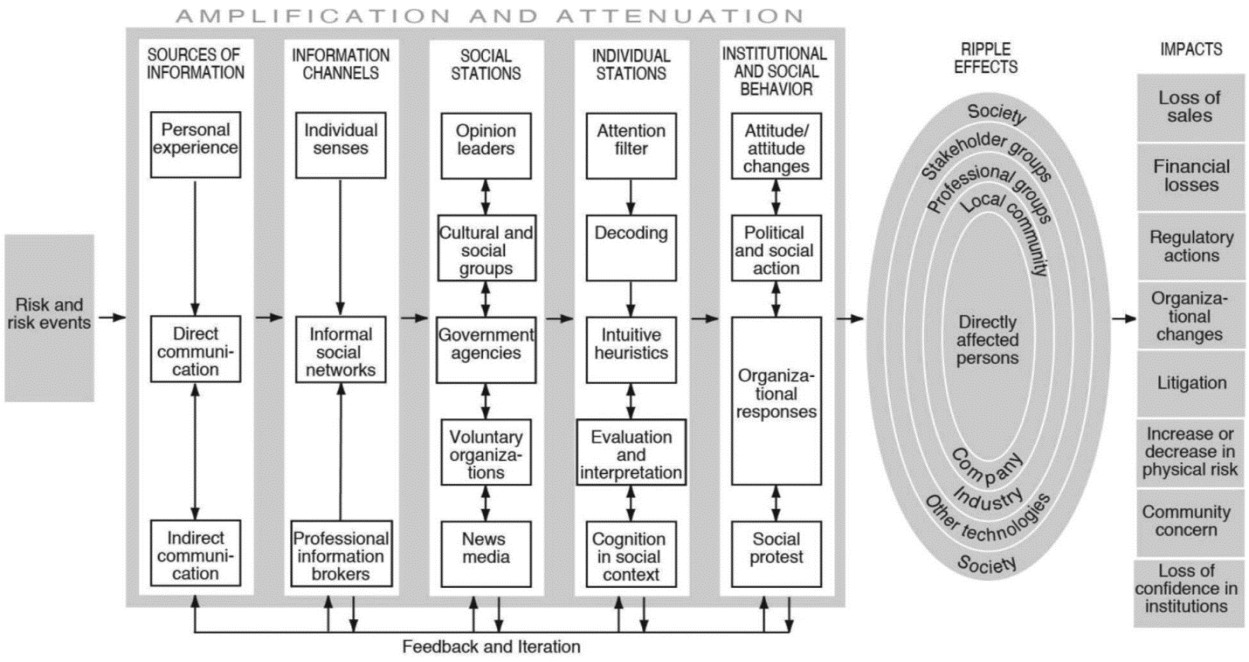

Figure 5 Social amplification of risk framework (SARF). Source: Kasperson and Kasperson (1996).

after a risk event occurs, there are a multitude of variables that factor into the impact of the risk. These include event characteristics and sources of amplification (or attenuation), including but not limited to personal experience, direct communication, indirect communication.

Information channels can come from individual senses, informal social networks, and professional information brokers. Social stations include government agencies, news media, opinion leaders, and cultural and social groups. Individual stations include a variety of processes including attention filtering, decoding, evaluating, and interpreting, intuitive heuristics, and cognition in social contexts. Institutional and social behavior is where potential attitude change occurs, political and social actional can take place, social protest, and organizational responses. These categories are not occurring linearly, but rather with continuous feedback and interaction from the other conditions. These collectively are what drive the ripple effects, where individuals

can be directly affected by the risk, with the 'ripples' spreading outward to the local community, stakeholders, and society. The impacts from this can vary from financial losses, litigation, and community deposition.

News media can serve as a social amplification station that produces and diffuses information (Kasperson et al., 1988). Studies have found that people often seek health information from non-medical sources such as the news media when trying to acquire information with regards to disease prevention (Lewis et al., 2012). In the event of public health crises, crisis communication techniques include warnings, risk assessments, and information about symptoms and medical treatment available (Veil et al., 2008).

Studies have explored the frequency and content of messages provided in the news media, some of which investigate the relationship between these variables and other vector-borne diseases, such as those conducted by Sell et al., (2018), Chan (2018), and Ophir (2020) for the case of Zika, and by Pellecer Rivera (2024) for both Zika and Chikungunya. From these studies we can see the role that news media can play in public risk perception. The three message categories that were selected for analysis come from Sell et al. (2018) where the frequency of risk-related news media messages in 2016 were being investigated regarding Zika virus, and as utilized by (Pellecer Rivera, 2024). The individual codes used for analysis in this study have been adapted to fit the nuances of tick-borne disease as opposed to the mosquito-borne disease discussed in those studies.

The three message categories included *risk elevating*, where statements were thought to increase perception of risk, *risk minimizing,* where messages were thought to decrease the perception of risk, and *guidance messages,* where the news media was further providing information regarding the nature of TBD or specifically Lyme disease that was not identified as being amplifying or attenuating, but rather neutral and informative. The volume of coverage from

news media sources during epidemics has been found to correlate with risk perceptions and protective behaviors (Chan et al., 2018), and this role will be further discussed below and explored along with the content of messages in the present study.

2.2.1 Volume

Volume and frequency of messages can influence the perception of how serious an event is by intensifying the risk (Kasperson et al., 1988; Mazur, 1984; Renn, 1991; Slovic, 1987). Particularly where direct personal experience is lacking, the mass media serve as amplification stations (Kasperson et al., 1996) with the extent of media coverage, volume of information provided, and ways in which the media is framed all playing integral roles in shaping group and individual views. Large volume flow of information can serve as a risk amplifier, independent of the accuracy and particular content of the information provided (Kasperson et al. 1988). Given the wide-spread accessibility, the media can play one of the most crucial roles in dissemination of information to the public (Schwitzer et al., 2005), particularly in the case of epidemics where the information must be digestible to the lay person (Chen et al., 2020; Rowan, 1991). Mitigation messages may carry more weight with experts, whereas the public may require the message to appeal more to emotion to address their personal level of efficacy (Sandman, 1987, 1993).

The impact of high levels of media reporting on the perceptions of disease was investigated (Young et al., 2008), with the results showing that diseases that occurred frequently in the media were considered to more serious and to have a higher disease status than those that received low media frequency. In addition, estimates of severity positively correlated to popular print media frequency. This effect can create a cycle of amplified public perception of risk by further stimulating additional media coverage, despite the actual level of risk present (Kasperson et al., 1988). Smith et al., (2019) found this to be the case in Maine regarding TBD in the state, evaluating

the burden of TBDs as opposed to comparable community-acquired infections through their count of hospitalizations, deaths, and news articles. This is the first analysis we have come across that assessed news media as a variable in TBD in the state of Maine.

Smith et al.'s study looked purely at the frequency (count) of news articles that mentioned Maine and Lyme disease from January 01, 2014, through December 31, 2018, a five-year time span that falls in the middle of the analysis period presented in this paper. They found that TBDs receive disproportionately higher media attention when compared with other infections important to public health, such as non-vector-borne diseases of Hepatitis B, C, HIV, Influenza, and Endocarditis with drug use (Smith et al., 2019). This is consistent with results of poor (Frost et al., 1997) or no (Kristiansen, 1983) relationship between the frequency of reporting deaths and mortality rates. The results from this study go to show the role that news media can serve as an accessible source of information to bring scientific and technical information to the public, which is particularly important to inform the lay person about emerging diseases (Binder et al., 2015).

However, news media coverage of hazards has been historically biased, overreporting stories such as violent causes of death and underreporting diseases, with the articles messages containing an emphasis on the negative information, contributing to the difficulties to discern the true level of risk (Combs & Slovick, 1979). Our study further investigates the overall frequency, but also but content of those news articles through a variety of message types to improve our understanding of if the messages are working to potentially amplify or attenuate risk perceptions surrounding TBDs in Maine.

2.3 Data Generation Method: Content Analysis

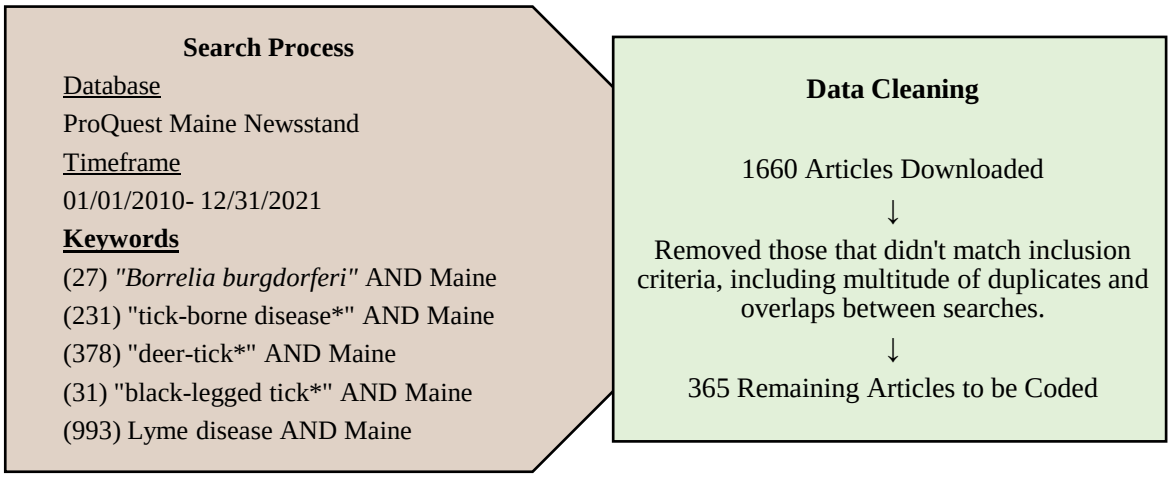

Figure 6. News media article search and selection process.

ProQuest-Maine Newsstand, an online newspaper database was utilized to retrieve the news media. This allowed for the generation of a list of online newspaper articles relating to Maine, published in the state over an eleven-year period, between January 1st, 2010, and December 31st, 2021. Searches were performed on this database using the following keywords: (1) "Borrelia burgdorferi" AND Maine, (2) "tick-borne disease*" AND Maine, (3)"deer-tick*" AND Maine, (4) "black-legged tick*" AND Maine, (5) "Lyme disease" AND Maine. This search yielded 1660 qualifying articles, which were then downloaded, and read in NVivo 12®. News media that did not match our inclusion criteria were removed. Those that were removed during this process included articles containing video, broadcasts, or transcriptions as the bulk of the content were removed, including duplicated articles, i.e. same article content, even if different title, publisher, or publication date, if they did not contain more than two sentences regarding one of the search terms, if it was published outside of the state of Maine, or if it was published before January 1st, 2010, or after December 31st, 2021.

An intercoder reliability assessment was conducted with two coders reviewing 25% (91/365) of the downloaded news article based on a random selection (Riffe et al., 2014) to generate a sound

coding scheme. Nine rounds of coding comparisons were completed to assess the intercoder agreement, determined by the Kappa coefficient calculated by NVivo 12©. Following each round, conversations were held between the coders to work through misinterpretations and disagreements, adapting the definitions of the coding protocol accordingly. Resulting codes with Kappa values over 0.61 represented strong agreement (McHugh, 2012). Codes reaching this threshold were kept, including those that received few news articles coded during the intercoder agreement sessions, as well as those that were deemed essential to the analysis process. By developing a standardized codebook, quantitative content analysis can be utilized to code content systematically and to allow for statistical analysis (Metag, 2016). Intercoder agreement is essential because it provides validation for the coding scheme, demonstrating that the obtained ratings are not the result of solely one individual's judgment (Neuendorff, 2017). Following this process, the remaining articles were coded using the adjusted codebook.

Once every article had been coded (365), NVivo 12© was used to perform coding comparisons, text frequencies, and crosstab queries to investigate patterns within the data (Bazeley & Jackson, 2013). Following Sell et al.'s (2018) and Pellecer Rivera's (2024) research on news media content surrounding Zika (Sell) and Zika and Chikungunya (Pellecer Rivera), the present study focused the analysis on the frequency of coverage and content targeting both risk elevating, risk minimizing, and risk preventing behavior messages. Heath messages and personal preventative behaviors were further examined to address the first two research questions.

2.4 Results

Figure 7 displays the frequency of Lyme disease cases in Maine per 100,000 population as well as the count of articles published in Maine during the same period of time of 2010-2021. Overall, a relationship does exist between the variables of Lyme disease rate in Maine and TBD

articles, with a correlation coefficient of (0.414). Both variables were following a trend of increasing overall with 2019 exhibiting a peak of Lyme rate with 162 cases per 100,000 population. TBD articles also had their third highest year in 2019 with 44 articles published. The following year, 2020, saw a stark decrease in both variables with the Lyme rate dropping to 83 per 100,00 a 49% decrease from the year prior, with TBD articles also dropping to 28 published in 2020, a 36% decrease. The volume of TBD articles has exhibited this fluctuation in the years of 2014 to 2015, where there was also a 37% change between those two years. Overall, Lyme cases increased 48% from 2010 to 2021, going from a rate of 57 to 110 cases per 100,000 population, with TBD articles increasing as well from 16 in 2010 to 25 articles in 2021, displaying a 36% increase across the study period.

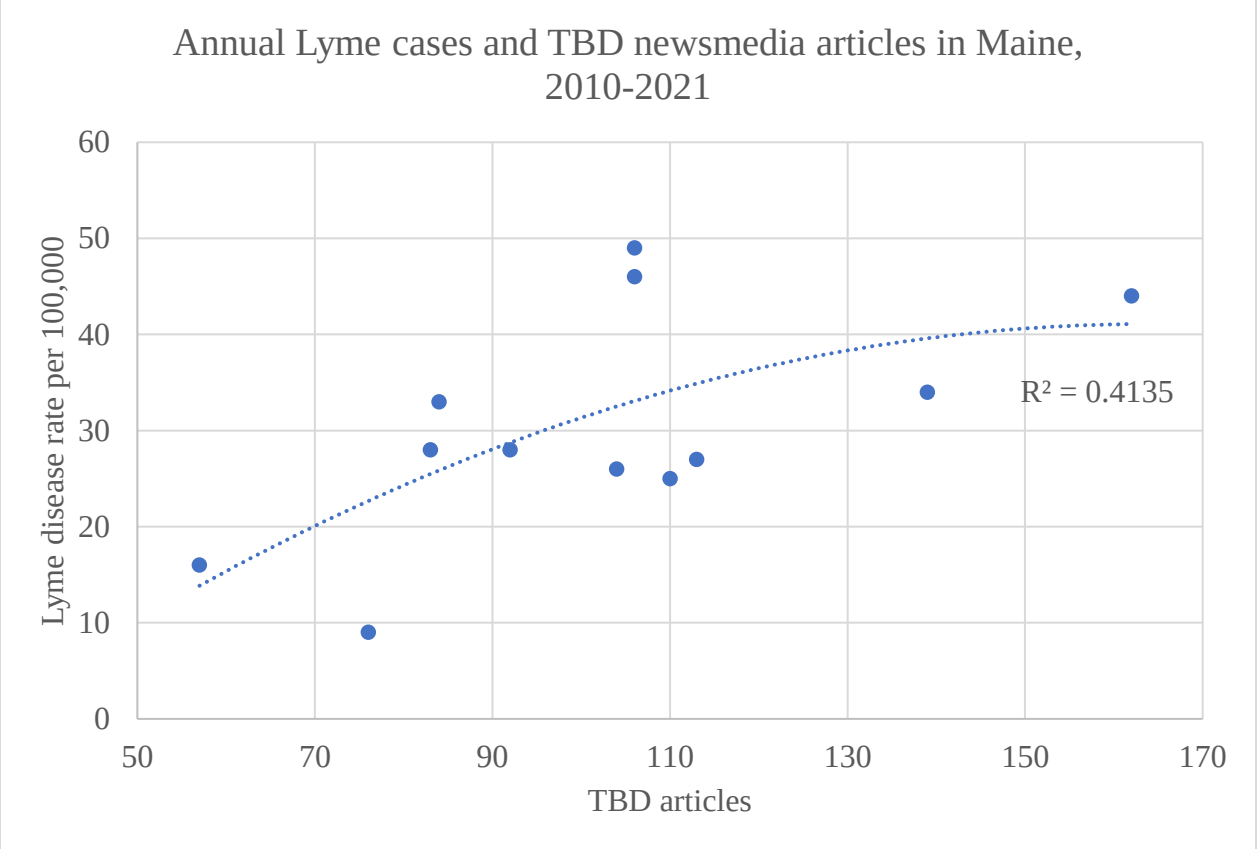

Figure 7. Lyme disease rate in Maine per 100,000 (Source: Maine CDC's Infectious Disease Epidemiology Program) and article volume from present study given search criteria 2010-2021.

2.4.1 Message Frequency

Of the 365 TBD-related news stories included in the analysis, 339 (93%) presented risk-elevating messages, with the most prevalent risk-elevating message (Table 1) referring to the source of transmission for Lyme disease being the black-legged tick 221 (61%), followed second by the presence of other TBD in Maine, including anaplasmosis, babesiosis, and Powassan virus. Over a third of all articles included messages of Lyme disease transmission increasing in Maine 178 (49%), symptoms of the disease being fever, headache, and fatigue 123 (34%), joints, heart, and nervous system 121 (33%), and messages including challenges present in testing or diagnosis of Lyme disease 121 (33%). The least common risk-elevating messages present included transmission of Lyme without the bite of an infected tick 6 (02%), tick control efforts not being effective 14 (04%), and the lack or limited presence of countermeasures 15 (04%).

Three coding groups were developed to synthesize a variety of the risk-elevating messages (Table 1). These included TBD in Maine specific messages 246 (67%), symptoms of Lyme disease 157 (43%), and challenges post TBD contact 152 (42%).

Table 1. Frequency and percentage of TBD articles that possess risk-elevating messages (2010-2021)

	f	**%**
Risk-elevating messages - Overall	*339*	*93*
You can get Lyme without getting bit by an infected tick	6	02
You can get Lyme disease from a black-legged tick	221	61
Pets can get infected with Lyme/other TBD	24	07
Tick control efforts are not effective	14	04
Mentions demographic that has higher/highest likelihood of contracting Lyme	37	10
No or limited countermeasures	15	04
Lyme disease is not fully understood by science	45	12
Prevention tactics are controversial or may cause problems if conducted	49	13
TBD in Maine	*246*	*67*
Lyme disease cases are increasing in Maine	178	49
Transmission is widespread in Maine	84	23
Other TBD present in Maine are Anaplasmosis, Babesiosis, Powassan virus	144	40
Symptoms	*157*	*43*
Infection could cause target rash	100	27
Infection could cause fever, headache, fatigue	123	34
Infection could spread to joints, heart, nervous system	121	33
Challenges post TBD Contact	*152*	*42*
Individuals with Lyme could be asymptomatic	49	13

Challenges in testing or diagnosis	121	33
Challenges with treatment	65	18

Risk-minimizing messages were presented in 304 (84%) of the studied newspaper articles (Table 2). Messages discussing the efforts underway to reduce the risk of ticks and Lyme disease held the highest presence with 190 (52%), followed by the personal prevention tactics of performing a tick check 137 (38%), wearing bug spray 131 (36%) and wearing long, light colored clothing 112 (31%). At least one personal prevention tactic was presented in 162 (44%), with putting one's clothes in the dryer to prevent prevention as being presented the least of all minimizing messages 12 (03%). Following this, the three least presented messages included the statements of serious adverse events occur in a limited number of infected 19 (05%), transmission is not widespread in Maine 27 (07%) and transmission in pets can be prevented with preventative treatment 24 (07%). Attenuating health messages were presented in 100 articles (27%), with the primary statement addressing the Lyme disease can be treated 94 (26%).

Table 2. Frequency and percentage of TBD articles that possess risk-minimizing messages (2010-2021)

	f	**%**
Risk-minimizing messages - Overall	*304*	*84*
Transmission is not widespread in Maine	27	07
Not every tick carries Lyme	54	15
Personal efforts to minimize risk at landscape level	69	19
Infection in pets can be prevented with preventative treatment	24	07
Attenuating Health Messages	100	27
Lyme disease can be treated	94	26
Serious adverse events occur in a limited number of infected	19	05
Efforts addressing TBD risk	204	56
Efforts are underway to test ticks for disease	70	19
Efforts are underway to reduce the risk of ticks and Lyme disease	190	52
Personal Preventative Behaviors	*162*	*44*
Infection can be prevented by performing a tick check	137	38
Infection can be prevented by tucking pants into socks	52	14
Infection can be prevented by wearing bug spray	131	36
Infection can be prevented by wearing long, light colored clothes	112	31
Infection can be prevented by putting clothes in dryer	12	03

Guidance messages were presented in most articles 334 (92%) with sources provided in 284 (78%). Environmental conditions that impact ticks were offered in 126 (35%) of articles,

followed by mentions of seasonality 102 (28%) and causations for the increase of ticks other than climate change 75 (21%). Messages that provide post contact with a tick were provided in 163 (45%) of articles, which included guidelines for how to remove a tick 58 (16%), guidelines for testing 28 (08%), guidelines for how to treat the symptoms with modern medicine 89 (24%) how long the tick needs to be attached to transmit Lyme disease 52 (14%) while any message referring to a cause for TBD increase 129 (35%).

Table 3. Frequency and percentage of TBD articles that possess guidance messages (2010-2021)

	f	**%**
Guidance messages - Overall	335	92
The time of year when one can get Lyme disease is changing	22	06
Mentions seasonality	102	28
Guidance on recreating with pets	6	02
Guidance on where to recreate	53	15
Mentions environmental conditions that impact tick	126	35
Mentions guidelines for how to remove a tick	58	16
Mentions how long tick needs to be attached to transmit Lyme disease.	52	14
Source of information about the disease	284	78
Maine Medical Center for Research Institute (MMCRI)	67	18
University of Maine (UMaine) Cooperative Extension: Tick Lab	120	33
Center for Disease Control (CDC) and Maine CDC	167	46
Experts	167	46
Guidance Health Messages	*113*	*31*
Mentions guidelines for testing	28	08
Mentions guidelines on how to treat the symptoms with modern medicine	89	24
Mentions that alternative forms of medicine can be used to treat Lyme symptoms	16	04
Cause for TBD Increase	*129*	*35*
The increase of ticks can be caused by other factors besides climate change.	81	22
Climate change is responsible for the increase in ticks	75	21

Messages referring to sources of information presented in the articles were summarized in Table 3 the code for source. The CDC, including the Maine sector of the CDC was included in nearly half of the articles 167 (46%), with the same number of articles citing experts in the field of TBD as their source. The University of Maine Cooperative Extension Tick Lab was also among the top four most common sources cited with a third of articles citing this source 120 (33%), followed by the Maine Medical Center for Research Institute (MMCRI) at 67 (18%).

Following the coding process, the health messages surrounding Lyme disease were categorized by the purpose that they were serving of elevating, minimizing, or guiding readers on the risk of TBDs (Table 04). Risk elevating health messages were further categorized by symptoms provided 157 (43%) with 91 (25%) of those articles also including at least one message of a personal preventative behavior (PPB). The most frequently observed code in this category was the short-term symptoms of fever, headache, and fatigue being presented in 123 (34%) of articles with 72 (20%) of articles including a PPB message. The message referring to the post TBD contact challenge of individuals with Lyme potentially being asymptomatic was presented the least, only in 49 (13%) of articles, with only half of these messages also presented with PPB messages (24 (07%)

Table 4. Health Messages and Health Messages AND Personal Preventative Behaviors

Health Messages			**AND Personal Preventative Behavior**		
	f	**% overall**	***f***	**% of health message**	**% overall**
Risk Elevating	202	55	103	51	28
Symptoms	157	43	91	58	25
Target rash	100	27	68	68	19
Fever, headache, fatigue	123	34	72	59	20
Joints, heart, nervous system	121	33	68	56	19
Challenges post TBD contact	152	42	72	47	20
Asymptomatic	49	13	24	49	07
Challenges in diagnosis	121	33	53	44	15
Challenges with treatment	65	18	24	37	7
Risk Minimizing	100	27	55	55	15
Lyme can be treated	94	26	53	56	15
Serious adverse events rare	19	05	08	42	02
Guidance	113	31	58	51	16
Guidelines for testing	28	08	19	68	05
Guidelines for treating with modern medicine	89	24	46	52	13
Guidelines for treating with alternative medicine	16	04	04	25	01

Slightly over half of the articles that contained risk minimizing health messages also included PPB 55 (15%), similarly with guidance messages with 51% of guidance health messages also including PPB 58 (16%). Guidance for testing and messages implying the possibility of a

target rash were the health messages with the highest presence of PPB with 68% of articles with those codes also containing at least one PPB, 19 (5%) and 68 (19%), respectively. Conversely, challenges with treatment and guidelines for treating symptoms with modern medicine were the health messages with the least prevalence of PPB with only 37% of challenges with treatment also including PPB and guidelines for 25% of articles with messages of alternative medicine available also including PPB, 24 (07%) and 04 (01%) out of all the articles in the study.

Figure 8 below displays the health message themes and individual health message codes from 2010-2021 with an included polynomial trend line. The R^2 value indicates how strongly the trend line represents the data provided, R^2 values > 0.5 indicate a strong relationship between the trend line and the data. Two of the graphs below meet this criteria, those being the risk elevating health messages as a group as it shows an overall decreasing trend in presence across the study period (R^2=0.7018), and the graph for the code of a potential symptom of Lyme disease, the target rash. This code also showed a trend of decreasing presence throughout the study period (R^2=0.6631).

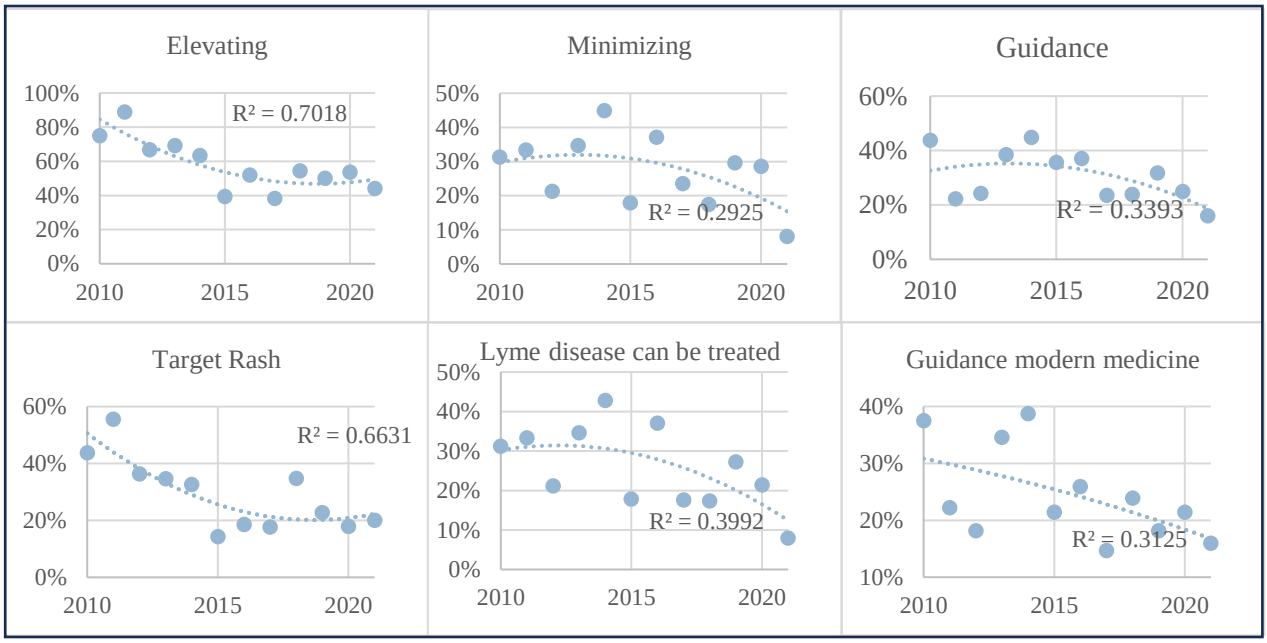

Figure 8. Health Messages Groups and Health Messages codes trends across study period.

The risk minimizing and guidance health messages shared similar trends with one another, slightly decreasing overall in presence from 2010 to 2021. Guidance pointing to using modern medicine to treat symptoms of Lyme showed a continuing downward trend, similarly to the message that Lyme disease can be treated that had a variable presence across the study period but overall ending 2021 with a presence of (08%) as opposed to its peak of (43%) of articles in 2014.

2.5 Discussion

Lyme disease poses a threat to the health and well-being of the residents and travelers to Maine. However, knowing that life would be dull without risk (Lupton & Tulloch, 2002), and how important the tourism sector is to the state of Maine, the way in which the risk of tick-borne diseases is communicated is of upmost importance, particularly as we consider the multitude of variables that affect the amplification or attenuation of risk messages, and therefor impact risk perceptions. News media can serve as an accessible source of information to translate scientific information into messages that can be accessible and digestible to the public (Binder et al., 2015; Chen et al., 2020), which is particularly essential with regards to the overall threat of tick-borne diseases as well as the intricacies of the risk and risk prevention measures available.

The research questions driving this data collection effort included what preventative measures are being suggested (RQ1), what are the health messages being presented (RQ2), and how, if at all, have the messages and coverage changed over time (RQ3). The first two questions were addressed through the frequency tables (Tables 1-3) where the message presence was broken down by risk-elevating, risk-minimizing, and guidance messages (Sell et al., 2018), with Table 2 specifically displaying the frequency and percentage of TBD articles that possess risk-minimizing messages, with a section that outlines the personal preventative behaviors (RQ1).

PPB were present in nearly half of all articles in this study. The recommendation that infection can be prevented by performing a tick check was presented in over a third of articles, making this the number one most recommended personal preventative behavior presented in the articles, supporting a variety of studies that found this to be the most practiced PPB (Valente et al., 2015; Butler et al., 2016; Omodior et al., 2015; Hook et al., 2015). The second and third PPB most provided included wearing bug spray, present in over a third of the articles, and wearing long, light colored clothing, present in just under a third of the articles. The frequent presence of these messages of self-efficacy further supported other research that found these to be the most common preventative messages (Eisen, 2022) as these are also the ones presented by the CDC (e.g. CDC, 2021; Maine CDC, 2024). It is alarming, however, that over half of the articles failed to provide messages of these PPB, while nearly all the articles included messages that amplified the risk of TBD with half of the articles in the study specially referring to increasing TBD in Maine (Table 1).

RQ2 was directly addressed in Table 4 as well, where the health messages were further categorized. Over half of the articles displayed risk elevating health messages, a quarter displayed risk minimizing health messages, and a third provided guidance health messages. Due to the treatability potential of Lyme disease (which a quarter of articles mentioned, Table 2), it was expected that the risk minimizing health message presence would be higher and closer to the guidance health messages percentage. However, when we look at the combination presence of the messages from RQ2 with personal preventative behaviors from RQ1, we see an equal representation across the three categories of health messages. Roughly half of all the articles including elevating, minimizing, and guidance half messages also included advice with PPB. This result was lower and more evenly distributed than expected. However, studies have shown that

even with increased awareness and availability of perceived risk, uptake of preventative behavior can be low (Aenishaenslin, 2017), with over half of respondents reported engaging in no preventive behaviors while participating in outdoor recreation, despite their knowledge of TBD (Hook et al., 2015).

When we then translate these results to the breadth of the study, on average half of the articles studied displayed health messages and displayed PPB, averaging a tenth of all articles included in this study. Risk elevating health messages were the most likely to also include PPB with a quarter of all articles including both, and risk minimizing, and guidance messages were just as likely as one another to include PPB at above a tenth of all articles.

Whether an article elicits risk or diminishes the risk potential, messages of self-efficacy to either counteract the risk being suggested, or to further the attenuation of risk through this inclusion, are essential. Repeated studies have demonstrated that possessing knowledge of ticks and TBD risk are significantly associated with performing routine tick checks on body and clothes (Gould et al., 2008; Omodior, 2015), therefor this is a piece of information that should not be excluded through any information dissemination around TBD.

RQ3 investigated how, if at all, messages changed over time. The results of this are displayed in two ways, the first being through Figure 1 where the volume of articles were compared to the rate of Lyme per 100,000 population in Maine across the study period. The number of articles published on TBD was found to have a consistent correlation with the number of cases being reported. This follows the theory put forth in the Social Amplification of Risk Framework (SARF), where information flow can be prompted by a risk event (Kasperson et al., 1988). For example, we can see that when a spike in cases occurs in 2019, the volume of articles increases accordingly. Similarly, in 2015, when there is a decrease in cases, we also see a drop in articles.

However, this trend was not always seen, such as in 2017 when cases jumped and the number of articles published did not increase at the same rate, increasing additionally in the year following this (2018) where Lyme cases conversely fell.

These disparities factored into the strong, yet not perfect correlation coefficient (R= 0.610). There are numerous factors that affect both the volume of articles and reported cases of Lyme. The relationship between these two variables can be important to monitor as volume can play the dule role of intensifying messages while increasing perceptions of the seriousness of the risk (Mazur, 1884; Kasperson et al., 1988; Renn, 1991; Young, 2008). A variety of messages coded through this study can aid in shining a light on potential factors that impact Lyme disease case rates.

Reported Lyme disease cases that are shown in Figure 1 as Lyme rate per 100,000 could have been affected by the many challenges in both the testing of Lyme disease, and with the reporting of the case amounts. Challenges in testing or diagnosis were presented in a third of articles, with guidelines for testing in over a quarter of articles studied. The CDC is forthcoming with data limitations as well, stating that definitions of confirmed cases change over time, and can result in year-to-year discrepancies in case amounts (Maine CDC, 2023). In addition, only Maine residents are included in the disease case counts, not considering the 1/6 visitors to the state who are not residents (Maine Office of Tourism, 2022b) and had the potential of acquiring a tickborne disease in Maine.

It is also important to note that individuals infected with Lyme do not always display symptoms (e.g. Steere, 2003; Hatchette, 2014), and over a tenth of articles provided messages that this event can occur. Target rash, erythema migrans, is a common symptom that is unique to Lyme where an individual develops a red ring rash either around the bite point or anywhere else in the body (CDC, 2022b). Just over a quarter of the articles in this study presented messages on this

symptom. However, this is not a reliable tell for if an individual is infected with Lyme because it has been reported to not occur on roughly a quarter of individuals who contract Lyme (Petersen, 1989; CDC, 2022b). In addition to these issues, the actual number of cases may be ten times more than the number reported due to underreporting and misclassification of the Lyme disease burden (CDC, 2024a; CDC, 2024b).

This study was designed following the onset of COVID-19 pandemic, however, not with the intent to investigate the role of that this played on the volume and content of TBD messages. This pandemic has been found to affect the diagnosis of Lyme disease two-fold (Wormser et al., 2021), with the range of overlapping symptoms associated with both TBD and COVID-19, and then in the case where diagnosis is sought, it was found that this process did not occur in a timely manner. The latter plays a role in both the progression and treatment for TBD, as well as the effect it plays on reporting, affecting case amounts such as those provided in Figure 1. In addition, it has been widely documented that the COVID-19 pandemic had an impact on who, how, and where people were recreating (e.g. Rice et al., 2020; Gabe, 2021; Maine Department of Agriculture, Conservation, and Forestry, 2021; Ferguson et al., 2022). As the participants of outdoor recreation change in Maine, it is imperative that we improve our understanding of recreationalists levels of knowledge and understanding of TBD to adapt our risk messaging to address the potential gaps in education regarding TBD.

The impacts of the COVID-19 on the volume of articles published on TBD and their content are hard to distinguish based on the results from the present study, as this study was not designed for that purpose. Figure 1 illustrates 2015-2019 with an upward trend for increasing frequency of TBD articles with a decline in 2020 and 2021, but the number of articles published in those two years were consistent with the 2015-2016 frequency. In addition, the presence of

articles that included the message that Lyme disease could be treated declined in 2020, appearing to not be consistent with the trend of this code during the study period, however the role that COVID-19 played in this occurrence cannot be determined. In addition, data points shown in Figure 2 do not indicate that the message content changed during the period of 2020-2021 as the presence of health messages were consistent with their previous trends.

As the world and Maine move forward in the post-pandemic new world, it is essential that we continue to review our understanding of who is recreating in Maine and where their understanding of TBD is to best support the pursuit of recreation in a safe manner. The role of COVID-19 on TBD is a potential avenue for future research endeavors, particularly if and how communication around this risk in Maine has changed based on the impacts of COVID-19.

It is essential to note as well that the comparison in Figure 1 does not consider other outside influences that affect this correlation and does not assume causation of these two variables. The nature of how TBD in the state of Maine is investigated was also undergoing changes throughout the period of this study. A variety of factors that may have played a role in the volume of articles published, including but not limited to those mentioned here. These include the Tick Act, introduced by Senator Collins, and brought into law in 2019 with the Title of Kay Hagan Tick Act (U.S. Department of Health and Human Services, 2023). Funding expired for MMCRI to investigate TBD, with this lab terminating identifying ticks in 2019, with University of Maine Cooperative Extension Tick Lab beginning to accept and identify ticks in the same year (Maine CDC, 2019). The role that these played on the volume of content being released and the narrative of the messages was not investigated through this study but may yield interesting results.

2.5.1 Limitations and Future Research

Lastly, the study design cannot be ignored as serving as an influence on number of TBD articles defined per the search parameter. Initial searches yielded articles that were not included in the final analysis, and the disparity exists due to the multitude of duplicate articles found during the data cleaning process. Duplicate articles were removed before coding if they held the same content and author as another article, despite a different title and different publisher to ensure that investigation of each articles content was unique. However, the articles that were eliminated could play a role in risk perception of TBD as pure frequency of messaging can have an influence on perception (Mazur, 1884; Kasperson et al., 1988; Renn, 1991). It was beyond the scope of this study to code each of these duplicated articles, and instead the focus was on unique articles that met our search parameters.

The present study analyzed newsprint media which has been used to analyze risk messages for some time (e.g. Frost et al., 1997; Sell et al., 2019, Smith et al., 2019, Riveria, 2024), however the role of other sources of information does not go unnoticed. The findings from this study can be used in conjunction with the findings of other content analysis of a variety of sources, including social media, television news, radio, and peers. Further research can be conducted to investigate how visitors and residents of the state are seeking, receiving, and interpreting information about emerging infectious diseases, as well as to understand how exposure to news media in particular plays into their perceptions, knowledge, and actions around health risks such as TBD.

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CHAPTER 3: IDENTIFYING AND UNDERSTANDING ACADIA NATIONAL PARK VISITOR PERCEPTIONS OF POTENTIAL RISK OF TICK-BORNE DISEASE

3.1 Introduction

Tick-borne diseases have been a rising threat to public health as the most reported vector-borne disease throughout the United States and Maine, where the state is experiencing a continued northern migration of Lyme disease with increasing cases year after year. Maine's economy has a high reliance on the tourism industry, with a heightened focus on outdoor recreation. Maine is also home to the Northeast's only National Park, Acadia National Park, known for its beautiful rocky coastline, miles of carriage roads, and a multitude of mountains. Of the nearly 4 million visits, over 90% occur during the months of May through October. Visitors are susceptible to both the perceived and real risk of Lyme disease due to the coupling of activities sought after in the park, as well as the temporal overlap of tick activity in the state. Consequently, it is essential to advance our understanding of how visitors perceive the risk of tick-borne diseases and what behaviors are being performed to reduce their exposure.

A mixed-mode visitor survey was conducted among visitors to Acadia National Park, originating with a five-minute intercept survey on site, followed by a longer, more comprehensive self-administered online-based survey instrument. The 624 respondents to the online survey were categorized into two groups: those with experience of tick-borne diseases and those without. Results showed statistical differences between experience and gender, visitation status, and TBD concern at location of residency. Experience was also found to have a significant role in the overall perceived risk of participants but not their overall protective behavior, with two thirds of all participants not consistently performing a tick check following potential exposure. These results

urge further investigation into the nuances of the lack of adoption of personal protective behavior to promote the health of all visitors regardless of their experience with TBDs.

3.2 Tick-Borne Diseases in Maine

The year of 2023 brought 2943 cases of Lyme to Maine, as well as an additional 777 Anaplasmosis cases and 194 Babesiosis cases (CDC, 2024a). Due to underreporting, the actual case load may be up to ten times higher (CDC, 2024c). Lyme disease, the most prevalent vector-borne disease in all of the United States is transmitted to humans primarily through *Ixodes scapularis*, the black-legged (deer) tick. The first Lyme disease incidence occurred in Maine in 1986 (Smith et al., 1990) and since then have become widespread. Cases across the US have increased 101% from 1992 to 2006 (Bacon et al., 2006) and have increased an incredible 280% from 1996 to 2022 (CDC, 2024b).

Black-legged ticks have a two-year life cycle with different activity levels at various points of the year (Yuval & Spielman, 1990), but (61%) of patients report experiencing symptoms during June, July, and August (Maine CDC, 2022). A 2021 report from the Maine CDC found arthritis to be reported in (32%) of Lyme cases, with erythema migrans present in under half the cases (47%).

Adult black-legged ticks experience two peaks in activity, most active first in the spring, then again in mid to late fall. Nymphal tick activity peaks in late June and larval ticks are most active in August and September, however this youngest life stage rarely utilizes humans as a host (Rand et al., 2007). Despite the general seasonality of Ixodes, ticks can be active at any time temperatures are above freezing, with most of their activity occurring when temperatures are above 40°F (Duffy & Campbell, 1994).

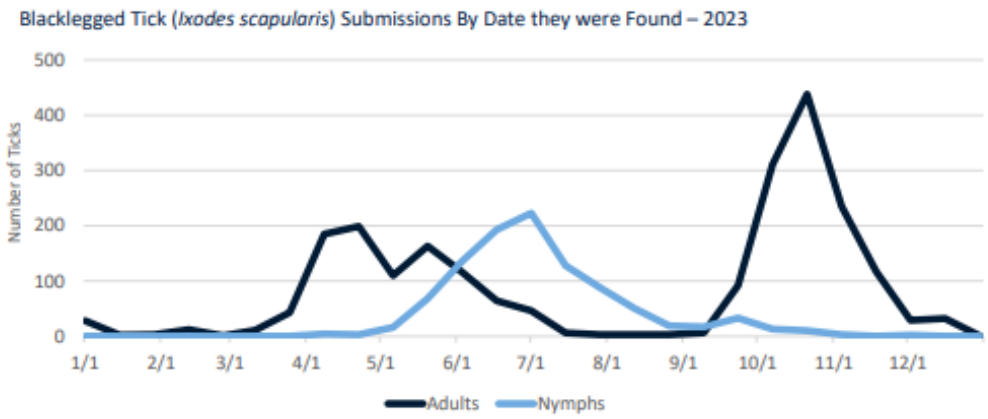

Figure 9. Ixodes scapularis submissions by date found in 2023. Image from University of Maine Cooperative Extension Tick Lab.

The Maine Centers for Disease Control (CDC) report yearly spikes in TBD diagnoses occurring from April to August, and again from August to September (Maine CDC, 2022). Approximately two-thirds of cases of Lyme disease in Maine are reported in the summer months of June, July, and August (MHIR, 2021). Figure 3.1 demonstrates the seasonal spikes in when black-legged ticks, the vector for Lyme, were found in the state in 2023. This is data from the University of Maine's Cooperative Extension's Tick Lab, where Maine residents can send ticks that they have found within the state for both identification and disease testing. From these submissions, the visual above shows the dual questing periods for adult and nymphal black-legged ticks, as discussed prior. You will see similar spikes when you look at a visitation to ANP, as will be further discussed in subsequent pages.

3.2.1 Lyme in Acadia National Park

ANP is within an area that is endemic for Lyme and other TBDs (CDC, 2024a). The park is located within Handcock and Knox Counties in Maine, USA. These counties have some of the highest incidences of TBD across the state. As displayed in Figure 3.2, in 2023, Handcock County had a Lyme Disease case count of 320 which is 564 per 100,000 population, and Knox County had the highest at 661 per 100,000 population (CDC, 2024a). The preliminary results for 2023 yielded

a similar outcome for cases of Anaplasmosis, with Handcock and Knox again being in the top counties with the highest rate of occurrence. It is important to note, however, that the actual risk in these areas have the potential to be drastically higher. Case cases counts as presented by the CDC cases are reported by an individual's county of residence, not county of exposure (CDC, 2024c). Insight into who is visiting and recreating in these areas, with potential to be at risk of TBD and not reported in the above statistics, will be discussed in the subsequent section.

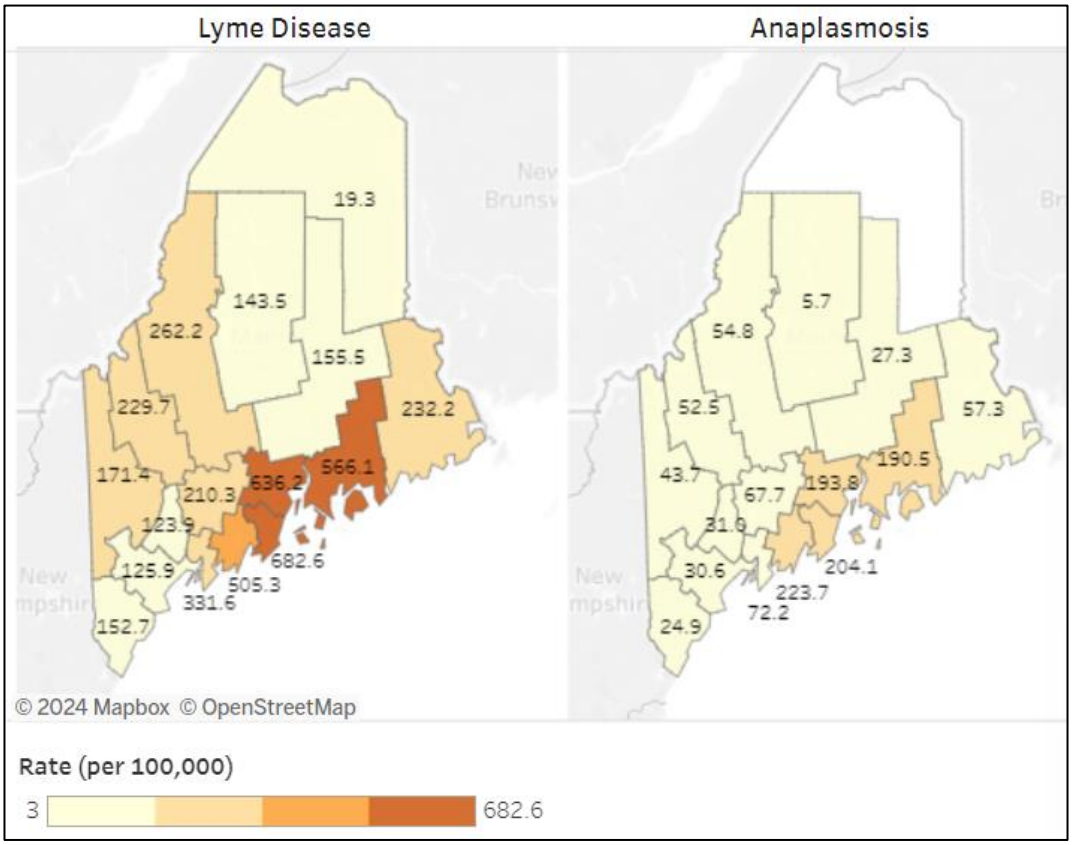

Figure 10. Map of cases of Tickborne diseases across counties in Maine, Preliminary results from 2023. Image from Maine CDC.

ANP is primarily located on Mount Desert Island, including neighboring coastal islands, and extending to the mainland with presence on School Peninsula (see Figure 3.3). There are many towns that are important to Acadia National Park as the park boundaries surround or touch many of these locations. Further, these village-towns rely heavily on the nature-based tourism that the

park attracts as a basis for their economy. In 2019, Bar Harbor had a rate of 353 cases per 100,000, Southwest Harbor had a rate of 399, and Mount Desert had a rate of 617 per 100,000 (CDC, 2024a). Mount Desert's rate was over three times higher than the state of Maine's rate of Lyme of 161 cases per 100,000. With this said, however, Lyme presence in Maine is still far above that of the rest of the US, with the country holding a rate of 11 per 100,000 in the same year (CDC, 2024b).

3.3 Tourism in Acadia National Park

The Northeast's only National Park resides in Maine, USA, off the coast in southern Maine. Acadia National Park is a four-and-a-half-hour drive from Boston, MA and under three hours from Portland, ME. The park experiences around 4 million visits each year, making it the fifth most visited park in 2022 (National Park Service, 2023).

What we know as Acadia National Park today, first gained federal designation under the name of Sieur de Monts National Monument in 1916 with a donation from figures such as philanthropist George B. Dorr, summer resident John D. Rockefeller, and Harvard president Charles W. Eliot, among others (National Park Service, 2023a). In 1919, President Woodrow Wilson signed the act establishing Lafayette National Park, and with a donation of land on the Schoodic Peninsula in 1929, the park adopted the current name of Acadia National Park. However, the beautiful scenery and natural resources of the area had long been enjoyed as the ancestral home of the Wabanaki people for more than 10,000 years.

ANP is primarily located on Mount Desert Island (MDI), the largest island off the coast of Maine with a year-round population of approximately 10,000 (Maine Office of Tourism, 2024). The park is roughly divided by Somes Sound to create east and west sides, with the east side of MDI being the most visited, and the west referred to by locals as the "quiet side". Key attractions in Acadia National Park include scenic coastal and mountain views, nature-based recreational

activities such as hiking, biking, boating, swimming, climbing, camping, and many cultural and historical attractions, such as the carriage roads, Park Loop Road, and Jordan Pond House.

A fire in the fall of 1947 burned over 17,000 acres of MDI, 10,000 of which were in ANP (National Park Service, 2020). The park used to be primarily made up of spruce and fir, common within the northern boreal forests. However, after the fire, early successional species such as such as birch and aspen, and later maple, ash, and oak, grew back in their place. Although these deciduous trees add spectacular views with their fall foliage, they also provide wonderful habitats for ticks, consequently correlating to higher tick densities (McBride, 2022), as well as white-footed mice and white-tailed deer that play crucial roles in the life cycle of black-legged ticks (Ostfeld et al., 2018).

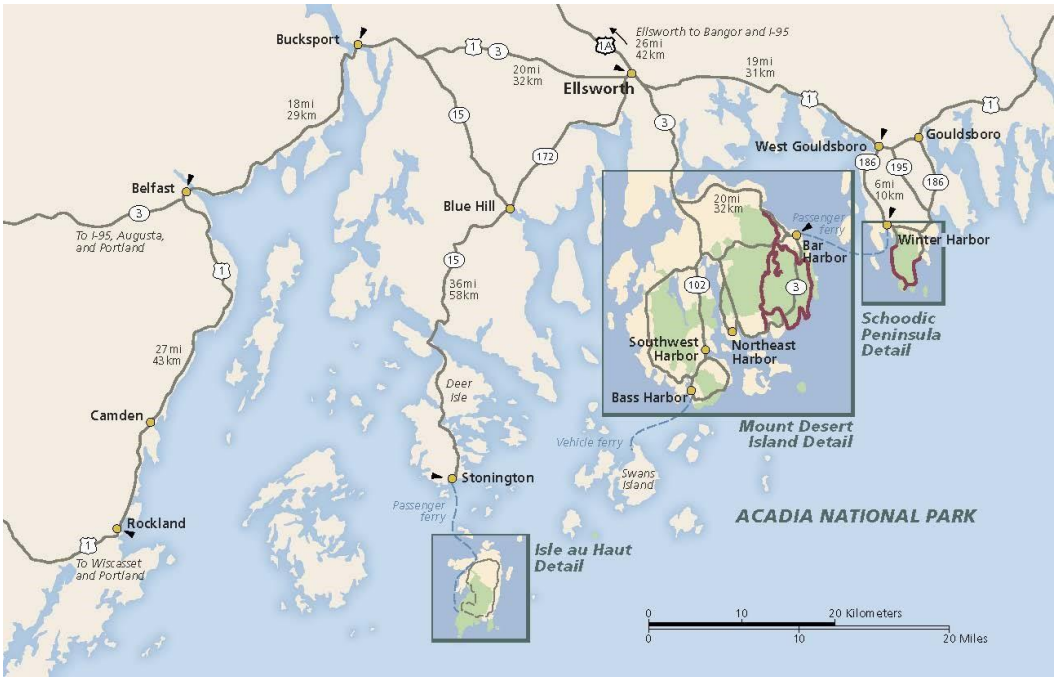

Figure 11. Map of ANP boundaries in relation to Mount Desert Island (MDI) and other islands off the coast of Maine. Image from National Park Service.

Acadia not only offers habitat for ticks, but it also provides an influx of potential hosts through their remarkable visitation. These visits are heavily grouped around the summer season, with July, August and September being the busiest months (National Park Service, 2022a). The

correlations between tick questing periods and times where there is an influx of visitors to ANP raises a cause for concern, particularly as the incidence of human pathogens has increased and the geographic range has expanded for the blacklegged tick (Elias, 2019; Elias et al., 2019).

Specifically, the number of visitors to ANP in 2023 averaged around 605,000 per month from May through October, making up 94% of the park's annual visitation, compared to month average of 41,000 visitors from November through April (National Park Service Visitor Use Statistics, 2024). These trends are going to be further enhanced by climate change with summer and shoulder season (spring and fall for ANP) visitation expected to grow (Fisichelli et al., 2015).

Visitation to ANP provided $479 million in visitor spending to the local economy in 2022 (National Park Service, 2022b), supported 6,700 jobs, $232 million in labor income, $394 million in value added, and $691 million in economic output in local gateway economies surrounding ANP (National Park Service, 2023). Visitor spending has more than doubled over the past ten years, with 2012 showing $201 million. Further, a survey conducted in 2016 showed that future visitation rates, public health, and economic success could all be influenced by increased vector-borne disease risk (De Urioste-Stone et al., 2016), and without the development of a vaccine or a stop in the transmission of TBD, the tourists driving the tourism industry in the area are left vulnerable (Donohue et al., 2015).

This study aims to determine whether experience with TBD influences risk perceptions and preventative behaviors. The surveys conducted in Acadia National and the resulting follow-up surveys provided a sample of visitors with varying socio-demographic backgrounds that were used to investigate if experience with TBD plays a role in TBD risk perception and protective behaviors. Our study hypothesizes that (1) visitors to ANP with experience of TBDs (either

themselves or someone they are close to) will have overall higher perceived risk, (2) visitors to ANP will report higher usage of protective behaviors then visitors without experience with TBDs.

3.4 Data Generation Method: Intercept and Follow-Up Surveys

3.4.1 Sampling Design

A mixed-mode survey was conducted on visitors to Acadia National Park. A two stage-cluster probability sampling approach (Dillman et al., 2014) was used in this study to select sample sites and dates, as well as which visitors to survey, at random. The intercept survey portion of this study occurred in the summer of 2019 starting on June 13th and ending on October 14th. The areas that were used to conduct the on-site surveys were Sand Beach, Sieur de Monts, Cadillac Mountain, Hulls Cove Visitor Center, Jordan Pond House, Echo Lake, and Thunder Hole. In the first stage, 18 dates and times were randomly selected to conduct the on-site survey (De Urioste-Stone et al, 2016). The second stage consisted of selecting visitor groups using interval probability sampling (every 2nd or 3rd group depending on how busy the day was) (De Urioste-Stone, et al., 2015). Participants from the intercept survey were presented with the opportunity to participate in the online survey (Dillman et al., 2014).

3.4.2 Questionnaire Design and Implementation

Intercept

All intercept surveys were conducted by graduate or undergraduate researchers who read questions to participants and entered their responses onto iPads using Qualtrics software. In less trafficked areas, researchers approached every group. One adult (whoever had the most recent birthday) from each group was asked if they would be willing to participate in the study (Dillman et al., 2014). The survey length was under five minutes, and then the researcher thanked the participants and gave them a postcard that had a personalized code and link to the self-administered

online survey. If willing, the researcher would collect either an email or mailing address from each participant. Of the 1907 visitors who completed the front-end questionnaire, 624 also completed the follow-up survey instrument, giving us a response rate of 32.7%.

Online

Visitors were asked to complete a self-administered online questionnaire after returning home. Those who indicated limited computer access, were mailed a paper copy and return envelope. Measures were previously tested during a previous visitor survey conducted in ANP (Soucy & De Urioste-Stone, 2020). The self-administered questionnaire consisted of 56 questions with three distinct sections: (1) basic trip information and thoughts about Acadia National Park, (2) knowledge about ticks and tick-borne diseases and how to prevent tick bites, and (3) background information and demographics. The first section included questions such as "What is the primary purpose of your trip," "How did you obtain information about Acadia National Park," and "Where did you visit in Acadia National Park." The second section used some questions that were on the intercept survey, such as "Do you know what a tick is?" along with more specific questions about tick habitat, tick bite prevention, and the diseases that ticks carry. Lastly, the third section asked participants about gender, age, educational background, and sources of information used.

3.4.3 Measures and Indices

Perceived risk

TBD risk perception has been identified as influencing the likeliness of performing personal protective behavior such as conducting a tick check, wearing protective clothing, and using insect repellent (Bayles, 2013; Soucy & De Urioste-Stone, 2020). Participants were asked to rank their level of agreement on a 7-point Likert scale of nine questions related to their perceived

risk of ticks and TBD, including statements such as: I am afraid of ticks, and I am at risk of Lyme disease when recreating outdoors, where -3=strongly disagree and 3=strongly agree. Respondent's answers to these statements were combined to create a single perceived risk score, with a score of -27 indicating the lowest perceived risk score and 27 indicating the highest possible perceived risk score.

Protective behavior

4-point Likert Scale questions were used to capture participants engagement in 4 personal protective behaviors. These behaviors included performing tick checks after being outside, wearing insect repellent, wearing protective clothing, and tucking pants into socks. Answers were coded so that 1=*never,* 2=*sometimes,* 3=*usually, or* 4=*always.* A sum score was calculated so that higher scores reflect higher overall protective behavior (α =.706). Scores are out of 16.

Experience

Using a select all that apply format, participants were asked if themselves, a close family member, a close friend, or a family pet had ever been diagnosed with any of the following tick-borne diseases. These included Anaplasmosis, Babesiosis, Ehrlichiosis, Lyme disease, and Powassan virus. If the answer was yes, participants were able to differentiate between who had what disease. A new variable was created in SPSS where respondents who did not answer yes to any of the options were recoded to (0= no experience with TBD) and those who answered yes to any of the options were recoded to (1= experience with TBD).

Knowledge

A knowledge score was generated from the sum of TBD-based knowledge questions where (0=low knowledge and 12= high knowledge). Knowledge questions included topics of tick-borne diseases in Maine (true/false), Lyme disease (true/false), and tick habitats (scale from 1: very

likely, 5: not very likely). Answers provided to TBD in Maine and Lyme disease were used to develop respondents' knowledge score, where each correct response garnished a point of 1, and incorrect or missing responses resulted in 0 points attributed. Results were used to compare those with and without experience with TBD.

Socio-demographics

A variety of socio-demographic information was collected include age, gender (1 = male, 2 = female, 4 = other, 6 = prefer not to answer), education (which was condensed into two categories where 0=college degree and 1= no college degree, home state/country, and whether or not this was their first visit to ANP (1 = Yes) and (2 = No).

3.5 Data Analysis

All data analysis was completed in IBM SPSS Statistics 28.0. There was a total of 624 responses to the self-administered online survey. A Pearson's chi-square test of independence (χ^2) was used to measure non-response bias and to compare those who responded to the intercept survey (n= 1907) and with those who completed the self-administered survey. There were not any statistical differences in knowledge of what a tick is (χ^2 =0.86, 2 df, p = 0.958), gender (χ^2 =1.502, 2 df, p= 0.472), and experience with TBD (χ^2 = 0.334, 1df, p =0.564). However, a statistical difference did exist with first time visitation ($\chi 2$ = 4.640, 1 df, p = 0.031), a higher percentage of those taking the online survey were repeat visitors to the park (43%) when compared to (33%) of the respondents to the intercept survey being repeat visitors.

A segmentation analysis was performed to segment the ANP visitors who responded to the online survey. This yielded two visitor groups, those with experience with TBD and those without TBD experience (Table 5). The group experience with TBD included those who either personally were or knew of someone close to them who was diagnosed with a TBD, including Anaplasmosis,

Babesiosis, Ehrlichiosis, Lyme Disease, and Powassan virus, all of which can be contracted in the state of Maine (CDC, Year). The group without TBD experience included those who did not select any of the above conditions.

Table 5. Characteristics of visitor segmentation resulting in two experience groups

Variable	Description	N
Experience with TBD	Responded yes to any of the following conditions: *Have you, a close family member, a close friend, or a family pet ever been diagnosed with any of the following tick-borne diseases?* *Anaplasmosis* *Babesiosis* *Ehrlichiosis* *Lyme Disease* *Powassan Virus*	244 (39.1)
No Experience with TBD	Did not experience any of the above conditions.	380 (60.9)

Independent samples t-tests were used to test for differences with the continuous variables for perceived risk, and protective behavior. A One-Way ANOVA test was used to compare the means of the two groups for the continuous variables of perceived risk and protective behavior to see if they possessed a normal distribution, and a Levene's statistic test was used for the assumption of equal variances of the groups. Barriers to protective behaviors against TBD were investigated using descriptive statistics. Chi-square tests were used to investigate if differences existed between the groups in respect to socio-economic and demographic variables. These scores along with Cramer's V were reported for effect size.

3.6 Results

3.6.1 Demographic Profile, Trip Characteristics, Potential Travel Behavior Change

As shown in Table 6 which displays results from the online survey, the majority travelled to ACAD with family (77%), were first time visitors to the park (58%) and were female (59%). The largest education group were those with a college degree (86%), which include those with an

Associates, Bachelors, or higher graduate degree. The top three age classes included those who were between the 60-69 (23%), 50-59 (20%), and 40-49 (20%), with the smallest age representation being those older than 69 years of age (07%). Lastly, most respondents (89%) reported that ticks and TBDs are a concern where they live.

Table 6. Comparisons of socio-demographic information and trip characteristics by experience group, reported as percentages.

Variable	**Overall %**	**Experience w/TBD (%)**	**No Experience w/TBDs (%)**	**Chi-Square (sig)**	**Cramer's V (ΦC)**
Gender	N=469	N=242	N=227	6.85	0.121
Male	41	36	47	(0.033)*	
Female	59	64	53		
Age	N=445	N=233	N=212	5.135	0.107
<30	13	12	15	(0.400)	
30-39	17	16	19		
40-49	20	18	22		
50-59	20	22	18		
60-69	23	24	21		
>69	7	8	5		
Education	N=469	N=243	N=226	0.789 (0.374)	0.041
No college degree	14	15	12		
College degree	86	85	88		
Politics	N=448	N=235	N=213	4.157 (0.125)	0.096
Liberal	54	58	50		
Independent	16	16	15		
Conservative	30	26	35		
Visitation	N=609	N=242	N=367	20.574	0.184
First time visitor	58	46	64	(<0.001)**	
Repeat Visitor	43	54	35		
Personal Group	N=468	N=242	N=226	1.991 (0.737)	0.065
Alone	04	05	3		
Family	77	75	80		
Friends	08	08	7		
Family and Friends	09	10	9		
Other	02	03	02		
Are ticks and TBDs a concern where you live?	N=466	N=241	N=225	21.495	0.215
				(<0.001)**	
Yes	89	96	83		
No	11	4	17		

*p<0.05; **p<0.001

Table 6 also compares the results of those with TBD experience, those without TBD experience, in a variety of socio-demographic characteristics. A statistical difference does exist between genders of those with experience in TBD having a higher proportion of females (64%), (χ^2 (2, N = 469) = 6.85, p = 0.033). In addition, visitation also yielded a statistically significant

difference (χ^2 (1, N = 609) = 20.574, p = <0.001) with those without experience with TBD holding a higher percentage (64%) of first-time visitors to ACAD. No statistically significant differences exist in the variables of age (χ^2 (5, N = 445) = 5.135, p = 0.400) and education (χ^2 (1, N = 469) = 0.789, p = 0.374).

3.6.2 Protective Behavior

Respondents were asked how often they perform a variety of questions to investigate their behaviors to protect themselves against the against the risk of TBD, the variables for which can be seen in Table 7. In this table, the results are shown comparing the two experience groups with the results of the survey respondent population. Two of the behaviors proved to hold a statistically significant difference between the experience groups, those being performing a tick check (χ2(3, N= 574) =26.855, p=<0.001) and tucking pants into socks (χ2(3, N=574) =9.673, p=0.022).

Table 7. Comparisons of protective behaviors against TBD by experience group, reported as percentages.

Variable	**Overall**	**Experience (%)**	**No Experience (%)**	**Chi-square (sig)**	**Cramer's V (ΦC)**
Performing a tick check	N=574	N=244	N=330	26.855	0.216
Always	34	40	30	(<0.001)**	
Usually	42	46	38		
Sometimes	18	11	23		
Never	6	2	9		
Wearing protective clothing	N=573	N=243	N=330	4.724 (0.193)	0.091
Always	17	14	20		
Usually	38	42	35		
Sometimes	40	40	40		
Never	05	04	05		
Tucking pants into socks	N=574	N=244	N=330	9.673	0.130
Always	10	7	12	(0.022)*	
Usually	16	17	15		
Sometimes	29	35	25		
Never	44	40	47		
Using insect repellent	N=572	N=243	N=329	2.388 (0.496)	0.065
Always	16	17	16		
Usually	33	34	33		
Sometimes	44	38	43		
Never	10	11	9		

*p<0.05; **p<0.001

Differences existed between the other two behaviors, with always wearing protective clothing occurring more often in the group with no experience (20%) as compared to (14%) of those with TBD experience always performing the same protective behavior ($\chi 2(3, N=573) = 4.724$, $p=0.193$). Lastly, using insect repellent yielded similar results between the two groups ($\chi 2(3, N=572) = 2.388$, $p=0.496$).

3.6.3 Perceived Risk

Table 8 shows a comparison between the perceived risk variables between experience groups. For visualization, the values shown have been condensed to three responses. All other analysis was performed using the full extent of the Likert scale, those being strongly agree, agree, somewhat agree, neutral, somewhat disagree, disagree, and strongly disagree.

Table 8. Comparisons of perceived risk of TBD by experience group, reported as percentages

Variable	**Overall (%)**	**Experience (%)**	**No Experience (%)**	**Chi-square (sig)**	**Cramer's V (ΦC)**
I am afraid of ticks.	N=583	N=244	N=339	1.921	0.057
Agree	61	63	60	(0.383)	
Neutral	16	17	16		
Disagree	23	20	24		
I am disgusted by ticks.	N=578	N=240	N=338	2.425	0.065
Agree	63	66	61	(0.297)	
Neutral	19	16	21		
Disagree	18	18	18		
I worry about Lyme disease.	N=585	N=244	N=341	10.569	0.134
Agree	76	82	71	(0.005)**	
Neutral	12	08	14		
Disagree	13	09	15		
Lyme disease would have a negative impact on my life.	N=583	N=243	N=340	1.649 (0.436)	0.053
Agree	97	95	97		
Neutral	02	02	01		
Disagree	01	02	01		
I believe Lyme disease is difficult to cure.	N=581	N=244	N=337	9.160 (0.010)*	0.126
Agree	78	76	79		
Neutral	08	05	10		
Disagree	14	18	11		
I think Lyme disease is a serious condition.	N=585	N=244	N=341	0.936 (0.626)	0.040
Agree	97	96	97		
Neutral	03	03	02		
Disagree	<1	<1	<1		

Table 8. (Continued).

I think there is a great chance that I will contract Lyme disease after a tick bite.	N=583	N=244	N=339	5.405 (0.067)	0.096
Agree	47	52	43		
Neutral	23	20	25		
Disagree	30	27	31		
I am at risk of contracting Lyme disease when recreating outdoors.	N=583	N=244	N=339	5.193 (0.075)	0.094
Agree	83	86	80		
Neutral	9	6	11		
Disagree	8	6	9		
Having an outdoor pet increases my risk of contracting Lyme disease.	N=583	N=244	N=339	5.281 (0.071)	0.095
Agree	73	78	69		
Neutral	18	14	20		
Disagree	9	8	10		

*p<.05; **p<0.01

Two of the statements held statistically significant differences between experience groups. *I worry about Lyme disease* ($\chi 2(2, N=585) = 10.569$, $p=0.005$), with (82%) of those with TBD experience agreeing to worrying about Lyme disease, versus (71%) of the respondents without TBD experience agreeing to the same statement, as well as the phrase *I believe Lyme disease is difficult to cure*.

With the phrase, *I believe Lyme disease is difficult to cure*, the biggest difference we see is with those disagreeing with the statement. (18%) of those with TBD experience disagree to the statemen, while only (11%) of those without TBD experience disagreeing ($\chi 2(2, N=581) = 9.160$, $p=0.010$). *I think there is a great chance that I will contract Lyme disease after a tick bite, I am at risk of contracting Lyme disease when recreating outdoors,* and *having an outdoor pet increases my risk of contracting Lyme disease* all come close to significant differences between the two experience groups, ($\chi 2$ (2, N= 583) =5.405, p= 0.067), ($\chi 2(2, N=583) = 5.193$, p= 0.075) and ($\chi 2(2, N =583) = 5.281$, p= 0.071), respectively.

The strongest relationships between experience groups existed for the variable of *I think Lyme disease is a serious condition,* with (96%) of those with TBD experience and (97%) of those

without TBD experience agreeing with the statement ($\chi 2(2, N=585) = 0.936$, $p=0.626$). This level of agreement between the two experience groups was closely followed by the agreement for the statement *Lyme disease would have an impact on my life,* (95%) and (97%) agreeing to the variable for the respondents with TBD experience and the no experience groups ($\chi 2$ (2, N=583) = 1.649, p= 0.436).

3.6.3 Knowledge

Table 9 displays the questions utilized to generate a knowledge of TBD index, as displayed in Table 10. Five of the twelve questions held statistically significant differences between experience groups.

Table 9. Comparisons of knowledge of TBD by experience group, reported as percentages.

Variable	Overall (%)	Experience (%)	No Experience (%)	Chi-square (sig)	Cramer's V (ΦC)
A ticks' life cycle lasts 3 months.	N=151	N= 74	N=77	5.590	0.192
True	61	51	70	(0.018)*	
False [a]	39	49	30		
All types of ticks cause diseases to humans.	N=522	N=222	N=300	0.677 (0.411)	0.036
True	10	11	09		
False [a]	90	89	91		
During the summer, the chance of tick bites is higher compared to the winter.	N=549	N=229	N=320	3.634 (0.057)	0.081
True [a]	94	92	96		
False	06	08	04		
Ticks mostly fall out of trees.	N=474	N= 205	N= 269	0.420	0.030
True	09	08	10	(0.517)	
False [a]	91	92	90		
Ticks wait in shrubs/tall grasses.	N=538	N= 233	N=305	0.459	0.029
True [a]	97	97	96	(0.498)	
False	03	03	04		
Anaplasmosis is transmitted by ticks in Maine.	N= 135	N= 69	N=66	6.045 (0.014)*	0.212
True [a]	72	81	62		
False	28	19	38		
Babesiosis is transmitted by ticks in Maine.	N=146	N=75	N=71	14.357 (<0.001)***	0.314
True [a]	68	83	54		
False	32	17	46		
Lyme diseases is transmitted by ticks in Maine.	N=564	N= 240	N= 324	0.046 (0.831)	0.009
True [a]	100	100	100		
False	00	00	00		

Table 9. (Continued).

Powassan Virus is transmitted by ticks in Maine.	N=132	N= 66	N= 66	7.873 (0.005)**	0.244
True [a]	44	56	32		
False	56	44	68		
People can get Lyme after a tick bite.	N=575	N= 242	N= 333	0.664	0.034
True [a]	99	99	99	(0.415)	
False	01	01	01		
Ticks are born infected with the pathogen that causes Lyme disease.	N=349	N=170	N=179	5.678 (0.017)*	0.128
True	19	14	23		
False [a]	81	86	77		
Ticks get infected with the pathogen that causes Lyme disease from biting mice and other small mammals that are infected with the disease.	N=407	N=193	N=214	2.030 (0.154)	0.071
True [a]	94	96	93		
False	06	04	07		

[a] Denotes correct response.
*p<.05; **p<0.01; ***p<0.001

The question of a *tick's life cycle length* ($\chi 2(1, N=151) = 5.590$, $p=0.018$), showed those with experience with TBD were correct more than those without experience (49% versus 30%), with over half of all respondents answering this question incorrectly. With regards to which TBDs are transmitted by ticks in Maine, statistical differences existed for three of the four TBD transmissions in the state, with *Lyme disease* as the exception ($\chi 2(1, N=564) = 0.046$, $p=0.831$). Respondents with experience of TBD were more likely to correctly identify *Anaplasmosis* ($\chi 2(1, N=135) = 6.045$, $p=0.014$), *Babesiosis* ($\chi 2(1, N=146) = 14.357$, $p<0.001$), and *Powassan virus* ($\chi 2(1, N=132) = 7.873$, $p=0.005$) as being transmitted by ticks in Maine than those without TBD experience. Lastly, those without experience of TBD were statistically more likely to falsely believe that *ticks are born with the pathogen that causes Lyme disease* ($\chi 2(1, N=179) = 5.678$, $p=0.017$), with (23%) answering incorrectly as opposed to (86%) of those with TBD experience providing the correct answer to the same question.

Overall, respondents from both groups agreed and were correct in their response to the statement of *ticks waiting in shrubs and tall grasses*, with (97%) of respondents overall correct

($\chi 2(1, N=538) = 0.459$, $p=0.498$). Additionally, (99%) respondents were correct while responding to the question that *people can get Lyme from a tick bite* ($\chi 2(1, N=575) = 0.664$, $p=0.415$), and finally (94%) of respondents acknowledged that *ticks get infected with the pathogen that causes Lyme disease from biting mice and other small mammals that are infected with the disease* ($\chi 2(1, N=407) = 2.030$, $p=0.154$). The questions in Table 9 further serve as the factors in the knowledge index score presented in Table 10.

Table 10. Comparisons of perceived risk, protective behavior, and knowledge of TBD by experience group, reported as mean values.

Variable	Overall	Experience (N)	No Experience (N)	Levene Stat (sig)	T-test (sig)	Cohen's D
Perceived Risk	11.821 (585)	12.615 (244)	11.252 (341)	1.700 (0.193)	2.157 (0.016)*	0.181
Protective Behavior	10.1986 (574)	10.385 (244)	10.061 (330)	5.687 (0.017*)	1.508 (0.066)	0.125
Knowledge	6.494 (624)	7.475 (244)	5.863 (380)	12.065 (<0.001*)	9.086 (<0.001)**	0.696

*p<.05; **p<0.01

Independent samples t-tests were conducted between experience groups, with the results depicted in Table 10. A higher perceived risk score indicates a higher perceived risk, a higher protective behavior score indicates a higher account for conducting the protective behavior, and a higher knowledge score indicates a higher level of knowledge of TBD. Respondents with experience of TBD (M=12.615) reported a statistically significant higher perceived risk ($t(583) = -2.157$, $p=0.016$) than those without TBD experience (M=11.252). These scores were measured on a scale from -27 indicating the lowest possible perceived risk, to 27 as the highest possible perceived risk score. Additionally, a strong statistical difference existed with regards to knowledge of TBD between the two groups, with those with experience displaying increased knowledge on the topic (M= 7.475) where 12 was the highest possible score ($t(624) = 9.086$, $p<0.001$). On the contrary, although close, there was no statistically significant difference between the two groups

for protective behavior (t(574) = 1.508, p = 0.066), with those without experience of TBD reporting less protective behavior actions.

3.6.4 Implications of TBD Concern

Using a 7-point Likert scale, respondents were asked to report how strongly they agreed or disagreed to a variety of variables based on their possible concern for TBD, with results provided in Table 11. The two segmented groups shared common beliefs for a variety of the variables, including their shared disagreement for changing the time year in which they recreate outdoors, overall (N=67%) disagreeing with the statement ($\chi 2$ (3, N=452) = 0.601, p= 0.896).

Table 11. Implications of TBD between Experience Groups

Variable *Concern about TBD has caused me to:*	**Overall (%)**	**Experience (%)**	**No Experience (%)**	**Chi-square (sig)**	**Cramer's V (ΦC)**
Change my feelings about wildlife.	N=453	N=238	N=215	4.016	0.094
Agree	25	28	21	(0.260)	
Neutral	12	11	13		
Disagree	63	61	65		
Does Not Apply	1	1	1		
Change the types of outdoor activities I conduct.	N=452	N=238	N=214	3.564 (0.313)	0.089
Agree	23	26	19		
Neutral	09	08	10		
Disagree	67	65	70		
Does Not Apply	01	<1	01		
Change the times of year that I recreate outdoors.	N=451	N=238	N=213	0.601 (0.896)	0.036
Agree	20	21	19		
Neutral	11	11	10		
Disagree	68	67	70		
Does Not Apply	01	01	01		
Change the times of day that I recreate outdoors.	N=450	N=238	N=212	0.794 (0.851)	0.042
Agree	11	11	12		
Neutral	13	12	13		
Disagree	74	74	73		
Does Not Apply	02	03	02		
Change the locations where I recreate outdoors.	N=451	N=239	N=212	3.698 (0.296)	0.091
Agree	32	36	28		
Neutral	07	07	07		
Disagree	60	56	64		
Does Not Apply	01	02	<1		

Table 11. (Continued).

Increase personal protection activities when recreating.	N=450	N=238	N=211	9.443 (0.024)*	0.145
Agree	76	81	71		
Neutral	10	10	10		
Disagree	13	09	18		
Does Not Apply	01	01	01		
Keep my family out of tick-prone areas.	N=451	N=239	N=212	6.429 (0.092)	0.119
Agree	46	50	41		
Neutral	11	09	14		
Disagree	39	36	43		
Does Not Apply	04	05	03		
Reduce my outdoor activity.	N=449	N=238	N=211	1.011 (0.799)	0.047
Agree	14	15	12		
Neutral	11	10	12		
Disagree	73	73	73		
Does Not Apply	03	03	03		
Stop recreating outdoors.	N=451	N=239	N=212	2.112 (0.550)	0.068
Agree	04	03	05		
Neutral	05	05	06		
Disagree	86	88	84		
Does Not Apply	05	05	05		

*p<.05

Similarly, overall (N=74%) of respondents disagreed with the statement regarding changing the time of day in which they recreate outdoors, ($\chi 2$ (3, N=450) = 0.794, p=0.851), and overall (N=73%) disagreed with reducing their outdoor activity ($\chi 2$ (3, N=449) = 1.011, p= 0.799). The strongest level of disagreement across all the variables existed in the final statement, where respondents were asked if their concern for TBD has caused them to stop recreating outdoors. Overall, (N=86%) of all respondents disagreed with the statement ($\chi 2$ (3, N=451) = 2.112, p = 0.550).

There was however, one variable that yielded a statistically significant difference between the two experience groups, where (81%) of those with experience agreed, and (71%) of those without TBD experience agreed, and that was with regards to increasing their personal protective behavior ($\chi 2$ (3, N=450) = 9.443, p= 0.024). The second highest difference between groups ($\chi 2$ (3, N=451) =6.429, p= 0.092) existed with the statement of keeping my family out of tick-prone areas,

where (50%) of respondents with TBD experience claiming that this has held true for them, and only (41%) of those without TBD experience agreeing with this statement.

3.7 Discussion

The risk of tick disease can be reduced through uptake of personal prevention methods. However, the adoption of these behaviors has not been widespread or consistent. Improving our understanding of potential factors that contribute to utilization of these methods is critical for managing the human health risks surrounding the continued threat of Lyme and other TBD in Maine and Acadia National Park.

The participants of this study ranged in age from 18 to 81, consisted of slightly more female participants, tended to have a college degree, lean liberal in politics, be a first-time visitor to the park, and visit the park with their family. Tick checks were the most common form of preventative behavior, followed by wearing protective clothing and using insect repellent. Nearly two thirds of participants reported not always performing a tick check and nearly half reported never tucking their pants into their socks. Overall participants lacked knowledge of tick-borne diseases, however those with experience of TBD tended to know more about ticks and the diseases they carry in Maine.

Further, over three quarters of ANP visitors studied worry about Lyme disease and believe it is difficult to cure, with nearly all believing Lyme is a serious condition and would have a negative impact on their life. Over half of participants disagree that they would change the types of outdoor activities they conduct or the time of year that they recreate outdoors, with three quarters disagreeing that they will reduce their outdoor activity. On the flip side, nearly half of participants keep their family out of tick prone areas and three quarters claim that they increase their personal protection activities when recreating.

The hypothesis driving this study is that those with experience of TBD should behave differently than those without, however this yielded mixed results. Consistent with previous work (Beaujean et al., 2013; Van der Heijden et al., 2017; Valente et al., 2015), the current study revealed that those with experience of TBD were statistically more likely to perform a tick check. The act of tucking pants into socks was also statistically different between groups, with great disparity between performance frequency. Those without experience responded always or never to tucking their pants into their socks more often than those without experience of TBD. The lack of significance between groups for the other personal protective behavior adds to the literature where experience was not a strong predictor of risk reducing behavior (Shadick et al., 1997; Aenishaenslin et al., 2017).

Further, a statistically significant difference existed between genders of those with TBD experience, with females having experience nearly double as often as men. These results are opposite of the trend for males testing positive for Lyme more often than females in Maine in 2021 and 2022 (Maine CDC, 2022; Maine CDC 2023). Similar differences exist with regards to visitation, with first time visitors having statistically higher lack of TBD experience than those who has visited the park previously. To be expected as well, a statistical difference existed with those with experience reporting living in a place where TBD is a concern more often than those without TBD experience, supporting trends found in previous work (Aenishaenslin et al., 2015).

The socio-demographic variables of age, political affiliation, and education level did not yield statistical differences between those with and without TBD experience. Age has been found to play a role in participation of preventative behavior (Aenishaenslin et al., 2015; Valenete et al., 2015) and in case count of Lyme (Maine CDC, 2022), thus a difference was expected here as well,

and further work may explore the relationship of these variables on preventative behaviors in Maine to further our understanding on potential impacts of experience with disease occurrence.

Additional statistical differences existed in two of the questions that were used to determine individuals perceived risk index. These included worry for Lyme, where those with experience reported an increased worry for the disease, as those with experience believing that Lyme is difficult to cure statistically more than those without TBD experience. Both groups agreed for their disgust and fear of ticks, which based on the literature, is unfortunate, as lower levels of disgust have been found to be one of the strongest predictors of checking for ticks (Mowbray, 2014).

Evidence provided in Chapter 1 provides insight into the relationship between knowledge and risk perception as well as the highlighting the role that self-efficacy plays in preventative behavior motivation with varying levels of knowledge. The present study found those with experience of TBD to be statistically more knowledgeable of ticks and the diseases that they carry in Maine. The strong relationship may be due in part to how knowledge was measured, in this case as actual knowledge. Past research has used self-reported knowledge of TBD and has found mixed results (Gould et al., 2008; Bayles et al., 2013; Butler et al., 2016; Beaujean et al., 2013; Kellstedt et al., 2008).

Additionally, a bias may have existed with those with experience of TBD being more likely to respond to the knowledge questions, as you will see a low response rate for some of the questions in Table 9. This included questions on the TBDs present in Maine, including Powassan virus, Babesiosis, and Anaplasmosis, where these diseases had around a fourth of the responses that the question regarding Lyme being transmitted by ticks in Maine had. These low response rates were not present in the other questions used for the perceived risk and protective behavior index scores as displayed in Table 10.

Further, a potential limitation of this study includes the visitor segmentation that was achieved initially while conducting the intercept survey. To ensure an influx of visitors, the research design included surveying visitors at tourist hot spots throughout the park. It is essential to note that the segmentation that resulted from this might not be representative of the average visitor. For example, locals to the area or other repeat visitors may tend to avoid these areas as they tend to be crowded with limited parking availability, particularly later in the day.

Additionally, the second visitor segmentation, those who conducted the online, follow-up survey, may have been more motivated to participate if they held strong opinions on the topic of TBDs or had experience with TBDs, although experience and knowledge was not a requirement to participate. Further, the online platform of the follow-up survey potentially allowed for participants to look up the answers to the questions addressing their knowledge of TBD. The role that this played is unknown, however a strong influence in the results is not expected, as an incentive for answering the questions correctly was not inherently provided.

3.7.1 Future Research

Future studies could go on an in-depth exploration of the experience variable to tease out a variety of factors that may contribute to the impact that experience has on risk perceptions and behavioral actions. For example, this could be further investigated to see if the proximity of experience played a role in risk perception or adoption of preventative behavior. This could look at if the experience was personal (as in the participants themselves had the TBD) versus if the experience was external through a close acquaintance being diagnosed with the disease. Or this could look at experience temporally by investigating the role of the length of time since the diagnosis or time since treatment was completed, how bad their experience and the role of that on

risk perception, as severity of experience and degree of harm have been found to affect risk perceptions (Weinstein, 1989).

Further, as Beaujean et al., investigates, further studies could ask participants to include if they have been bitten by a tick even if a disease did not result (2013) to see how tick bite history affects those visiting the state. This could be interesting to see the role of a close exposure to risk could affect perceptions, particularly as not every tick is a carrier of the bacterium Borrelia burgdorferi (MHIR, 2021).

Additionally, the field of tick research could benefit from a broader understanding of the role of knowledge. For example, the relationship between knowledge of TBD and the consistency of performing personal protective behavior could be further explored as the present study compared knowledge between experience groups. Further, the present study investigated the role of actual knowledge, but there are a variety of questions that could be further asked of participants to receive a more complete picture of their understanding of the risk. For example, three different forms of knowledge could be explored, including declarative, procedural, and effectiveness knowledge (Kaiser & Fuher, 2003), or as Van der Linden suggests, casual, impact, and response (2015).

Overall, continued interest and attention devoted to understanding the motivations, barriers, and resulting prevention behavior is essential in a path forward to supporting the health and safety of those visiting Acadia National Park.

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CHAPTER 4: CONCLUSION

4.1 Introduction

Maine is 94% privately owned, is the most forested state in the country, and has year-round recreation opportunities available. Lyme disease is not new to Maine has it had been first identified in the state in 1986 (Smith et al., 1990) and has been increasing in abundance since, to case counts nearly reaching 3000 cases in 2023. Other TBD have also been on the rise, with Anaplasmosis, Babesiosis, and Powassan virus increasing in prevalence in the state, with potential diseases on the horizon yet not established in Maine as of now. However, the prevention for all of these TBD remains the same, regardless of the disease or the specific tick-vector of the disease. Performing tick checks, bug spray, long clothes are all effective measures in reducing one's risk (CDC, 2021). However, study after study, including the results presented in Chapter 3 show that participation in these behaviors is low and inconsistent, even with those with experience of TBD, despite frequency of the messaging in the news media as presented in Chapter 2.

As discussed in Chapter 1, risk perception is the subjective judgements placed on the perceived severity of negative occurrences (Slovic et al., 1980). The risk of contracting infectious diseases has been found to be among the most important criteria for tourists when measuring risks for travel (Sheng-Hshiung et al., 1997), with the potential to negatively affect visitor experiences (Huebner, 2012). Due to the underdevelopment or outright lack of tick management across the US, individuals are often left to self-manage tick prevention (Donohue et al., 2015; Eisen 2020). With the high reliance on the tourism industry in the state of Maine, it is essential that we further our understanding of the perceived risk of Lyme disease, the most common tick-borne infectious disease in the country. However, one's judgements of risk are not always as straightforward as stronger the risk, stronger the perception. Judgements of risk can be sensitive to a multitude of

factors, therefore are not as closely related to their own or experts estimates of annual fatalities (Slovic et al., 1982).

This chapter seeks to review the results of the two studies presented in Chapters 2 and 3 and consider the relationship between the content of news media (specifically newspaper articles) in Maine with the knowledge of TBD and performance of PPB by ANP visitors. Although our study participants were not entirely composed of Maine residents, the results may have some transferability and shine a light on gaps in communication present in our own state.

4.2 Review of Key Results

4.2.1 News Media Content Analysis

Overall, risk elevating messages were presented in the news media with increased frequency than messages that minimized the risk of TBDs. Messages informing individuals of the vector of Lyme, the black-legged tick was the most prevalent of the risk elevating messages, followed by statements discussing the increasing cases of Lyme in Maine. Risk-minimizing messages were primarily composed of information regarding the efforts underway to reduce the risk of ticks and Lyme disease in the state, followed by messages of personal preventative behaviors. Messages citing a source of information were provided in three quarters of the news media with the CDC and field experts as the most cited sources of information.

Articles largely failed to pair PPB messages with health messages, regardless of if they were elevating or minimizing the risk. Only a quarter of articles provided PPB with messages of Lyme symptoms, and the frequency was even lower for messages that referred to the treatability of Lyme and for guidelines for testing.

There was a correlation between Lyme cases with TBD newsprint media articles, but health message presence largely decreased over the course of the study. Specifically, health messages

that indicated an elevating level of risk decreased from 2010 to 2021, with the presence in the news media dropping by nearly half. Messages of guidance and minimizing the risk of Lyme exhibited a slight decrease in presence, but largely remained the same over the study period. Determining the cause of these trends were not within the scope of this study, but the spread of COVID-19 in 2020 and 2021 may have played a role.

4.2.2 Surveys of Acadia National Park Visitors

Chapter 3 explored if one's experience with TBDs impacted their knowledge, risk perception, and personal protective behaviors towards TBDs. One's experience, whether they were personally diagnosed with any one of five TBDs (Anaplasmosis, Babesiosis, Ehrlichiosis, Lyme Disease, or Powassan Virus), or if a close family member, a close friend, or a family pet had been diagnosed, proved to have significant effects.

Visitors with experience of TBD had significantly higher perceived risk, with a significantly higher level of worry for Lyme disease than visitors without experience of TBDs. Further, those with experience possessed more knowledge of TBD with a better understanding of the tick life cycle and TBDs transmitted by ticks in Maine than those without experience. Interestingly, personal preventative behaviors were not significantly impacted by the role of experience, but significant differences existed between groups in the performance of tick checks and the act of tucking pants into socks.

4.2.3 Integration of Results

Direct comparisons between the results of these two research components have not been conducted as respondents of the survey in ANP were largely out of state residents and the content analysis investigated Maine published news media. However, interesting comparisons can be

considered in what messages are provided to the public with what knowledge the visitor segments possessed.

Knowledge of Different TBD Messages that presented information that other TBDs were present in Maine such as Anaplasmosis, Babesiosis, and Powassan virus were presented in two fifths of all news media in the study. Visitors with experience of TBD were familiar with these diseases being transmitted in Maine, with over three quarters acknowledging the presence of Anaplasmosis and Babesiosis in the state, however only roughly half of those without TBD experience acknowledged the presence of these diseases. The knowledge levels of Powassan virus were even lower for those visitor groups, again with those with TBD experience with an increased knowledge of this disease. All visitors, however, knew that Lyme was transmitted in Maine.

Personal Preventative Behaviors Messages of personal preventative behaviors were presented in under half of all news media during the study period. Messages of performing a tick check, wearing bug spray, and wearing long, light colored clothing were among the most popular recommendations however they were only present in a third of all articles, despite nearly all the articles suggesting elevating risk messages. Three quarters of all respondents in the ANP survey indicated that they worry about Lyme disease, with nearly all agreeing that Lyme disease would have a negative impact on their life. Despite these beliefs, only a third of all respondents always perform a tick check with even fewer respondents reporting adopting other PPB, consistent with findings across the literature (e.g. Aenishaenslin et al., 2017, 2022; Vázquez et al., 2008).

Further, despite large presence of elevating risk messages presented in the media, respondents largely reported few implications based on concern for TBD, as presented in Table 11. This included the types of activities conducted, and how they go about participating in the activities, whether that be time of year, time of day, and location. Statistical differences did not

exist between experience groups for eight of the nine implications investigated, with only concern for TBD causes those with experience of TBD to report increasing personal protection activities when recreating statistically more than those without, despite a lack of significance between groups with the actual number of PPBs conducted, as presented in Table 9.

4.3 Future Research and Final Thoughts

Lyme disease is avoidable through well documented preventative behaviors; however, the rising case amounts indicate that there is a greater need for preventative behaviors now than ever. With repeated documentation of low levels of adoption of these practices across the literature and in the respondents to our ANP survey, a need for proper communication is more necessary than ever. Our study investigated the role of experience with tick-borne diseases on the variables of knowledge, perceived risk, and PPB, and put these results into context with the news media in Maine.

However, additional research is needed to promote the health and safety of those exploring Maine and ANP. Future research may need to further explore the reasoning of the low adoption of these risk-reducing behaviors that have been proven to be effective. A comparison of knowledge with PPB may yield interesting results, as the presence of PPB messaging is lacking in the news media in the state. An interesting exploration could involve studying what information visitors are seeking as well as their levels of trust with the information and potential sources of information. Another research aim could include providing visitors to ANP information with direct TBD messages to investigate behavioral implications of on-site messaging.

Further, lack of knowledge may only be one of many contributing factors for those visiting ANP, as our studies show that it is not for a lack of perceived risk. This may look like exploring the role of efficacy messaging with the perceived efficacy of individuals.

4.4 Interdisciplinary Process

The National Research Traineeship (NRT) aims to train the next generation of transdisciplinary conservation scientists through collaborative, solutions-driven research, professional development, and coursework. The NRT accomplishes this by integrating biophysical and socioeconomic sciences and bringing in non-academic partners to collaboratively address problems to prepare to address the challenges you will be faced with addressing post-graduation. There are five requirements for NRT trainees, including required courses, internships, annual retreats, self-assessments, and reflective journals. I will further discuss the role that the internship requirement had on my professional development and successful completion of my master's thesis.

The goal of this component of the NRT program is to provide students with the opportunity to directly experience organizational functions through public or nonprofit organizations with the focus on conservation planning, management and policy making based on individual's career and research interests. While collaborating with the program's partners, trainees are tasked with developing internship plans customized for their personal career goals to enhance the skills necessary to succeed following their graduate program.

My experience with this process shaped the trajectory of my graduate career. The NRT challenges the trainees to internally deliberate career interests and passions outside of their academic research. Not having done this before as I had not previously had a job outside of academia in my field, I explored internship opportunities available in Maine. I approached this with the idea that I would find one that generally aligned with my interests and would allow me to use it as a base in which I could adapt the internship to better align with my goals through the development of a unique, personal opportunity. Instead, I identified an existing internship that I believed to overlap exactly where my research experience and career interests intersected. The

position I found allowed me to utilize my existing skills while developing additional competencies that I believed to be essential to making the transition away from academia following my degree.

As I write now, I have since completed that internship with Friends of Acadia, working in Acadia National Park as a Recreation Technician. This experience has led me on a career path in visitor use management with a strong focus on outdoor recreation and wilderness. Following that summer, I have also completed an internship with the Ecological Society of America, serving as a Scientists in Park Fellow and Field Lead for Rocky Mountain National Park's trail encounter project, as well as Grand Canyon National Park's Wilderness and Visitor Use Lead as a Biological Science Technician. Further, I will be entering into a job with the Bureau of Land Management post-graduation. These opportunities would not have been possible if I had not been a member of the NRT which urges students to take the first step towards a career which they are passionate about. The skills earned by engaging with the broad array of experts in the field of natural resources that are our NRT partners, simply cannot be taught through traditional graduate courses.

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APPENDICES

APPENXIX A: CODEBOOK

CODING PROTOCOL FOR CONTENT ANALYSIS

Objective and research questions

The objective of the first phase of this research is to analyze the media content and message frequency on tick-borne diseases over the last 10 years, using content analysis of newsprint media from Maine. Through the content analysis we aim to answer the following research questions:

- What preventative behaviors are being suggested by the newspapers?
- What are the health messages being presented?
- How, if at all, have messages and coverage changed in the past ten years?

About the coding process and coding protocol

By developing a standardized codebook, quantitative content analysis can be utilized to code content systematically and to allow for statistical analysis (Metag, 2016). Intercoder agreement is essential because it provides validation for the coding scheme, demonstrating that the obtained ratings are not the result of solely one individual's judgment (Neuendorff, 2017).

Sampling

- ***Newspapers***

The articles analyzed come from newsprint media published in Maine, USA. To collect the newsprint media articles, the search was conducted using the following keywords

- "Borrelia burgdorferi" AND Maine
- "tick-borne disease*" AND Maine
- "deer-tick*" AND Maine
- "black-legged tick*" AND Maine
- "Lyme disease" AND Maine

ProQuest, Maine Newsstand was the only database used, including the period between

January 01, 2010 – December 31, 2021.

Eligibility

- ***Newspapers***

Newsprint media article is NOT eligible if:

1. it was duplicated (same the article content and author-when available), can have different title, publisher, or publication date
    a. only one copy of the same article was included in the database, but the total count of duplicates, if applicable were recorded
2. it was published outside of the state of Maine
3. it does not contain more than two sentences regarding one of the search terms

4. it was published before January 1st, 2010, or after December 31st, 2021

Coding instruction

Read through this coding protocol before beginning a coding session to familiarize yourself with the coding process. Do so before you begin each session to ensure that you understand each of the available codes and to be clear about the process. Each session should last a maximum of three hours, and it is recommended that a ten-minute break is taken after every hour that coding is conducted. These breaks should not occur in the middle of coding an article but rather once it has fully been completed to promote consistency.

For each coding session:

(a) **Be organized,** maintain the articles in order. Each article is identified with a number, and although not all the numbers included are continuous, it is recommended to follow the order to carry an organized coding process.

(b) **Read completely,** read the selected article from start to finish before coding.
   a. If the article does not comply with the eligibility criteria (described above), please do not code it, and register which and why is not eligible in the table. Then move on to the next article. If the article passes the eligibility criteria, then:

(c) **Code the selected article,** utilizing the codes described in the following section. Only code one article at a time. Fully code each article before taking a break to avoid confusion.
   a. Skip the abstract, do not include it in the coding, because not all the articles have one.
   b. Code at the paragraph level, i.e., highlight the entire paragraph even if there is only one sentence that is relevant to the selected code.
      i. In the case of a list, bulleted or not, code each item as if it was its own paragraph.

(d) **Record when completed,** when you finish coding an article, write down that you did so in the respective table. This will ensure a record of what has coded with the intent to avoid future confusions

Repeat all the steps described above (from "a" to "e") for each article.

Codes

1) Risk elevating

Code	Definition	Example
Challenges in testing or diagnosis	Uncertainty, lack, or failure in testing/diagnosis of the disease. Include messages of under-reported cases. Mentions probable cases	""Until medical doctors have a test that definitively identifies the presence or absence of infection (and such a test does not yet exist), the controversy about the diagnosis and treatment of chronic Lyme Disease will continue," its website says." (10). "Officials say many cases go unreported because people didn't know they were bitten" (23).
Challenges with treatment	Cost for treatment is too high. Insurance does not cover the cost. Messages that indicate that Lyme does not go away, no cure.	"…last June I approached a local physician requesting a small amount of doxycycline for Lyme disease prevention. I was refused and told there is a shortage of doxycycline. An Internet search revealed this is indeed true" (242). "But don't be fooled – there's no happy ending. Caesar is still alive, and still blogging, but her battle with Lyme disease will last her lifetime" (244). "Taking 50 or more pills a day, suffering through surgeries and lots of experimental trials, encountering huge expenses, leaning heavily on her parents to care for her and her young daughter, Caesar's life has been one long roller coaster ride" (244). "I am on disability and cannot afford the herbal remedies I need to treat my infections. My fees per month for the regimen I have to use are over $500. Legislation needs to be passed to have insurers cover expenses for all of our treatments, whether Western medicine-related or integrative." (385).
Individuals with Lyme could be asymptomatic	It is possible to have Lyme disease and not be aware. One may not show any signs or symptoms. People may not know they have been bitten.	"Symptoms include a bulls-eye rash —which occurs in about 50% of patients…" (80) "The bad news is that it doesn't always present itself the same way, and some people never have the characteristic "bull's-eye" rash for which it is best known." (326).

Infection could cause a target rash	Messages that state a target, bulls-eye, or Erythema Migrans rash may be visible from contracting Lyme disease.	"Symptoms include a bulls-eye rash —which occurs in about 50% of patients…" (80) "It usually starts with a circular rash that spreads over time." (326).
Infection could cause fever, headache, fatigue	Shorter-term complications Fever, headache, fatigue, flu-like symptoms are all possible early symptoms of Lyme disease.	"Symptoms include… fever, chills, headache, muscle and joint aches, and neurological problems, such as Bell's palsy." (80).
Infection could spread to joints, heart, nervous system	If left untreated, Lyme disease can cause many long-term complications to humans by the infection spreading to the joints, heart, and nervous system. Facial (Bell's) palsy/paralysis/body aches Post-treatment Lyme disease Messages that indicate that Neurological implications can occur from Lyme Include messages that indicate calling symptoms post-treatment Lyme disease syndrome Brain Fog "Chronic" Lyme disease	"If the infection is not treated, you may develop bouts of severe joint pain and swelling several weeks to months after you're infected. Your knees are especially likely to be affected, but the pain can shift from one joint to another." (107). ""It can be quite debilitating," Williams said. "Your bones just hurt. Some days you can't even get out of bed," he recalls his friend saying. "You go through cycles. You may feel good for two or three months, then it hits you and you're feeling down."" (8). "Called post-treatment Lyme disease syndrome, people may experience persistent pain, fatigue, impaired cognitive function or unexplained numbness" (83). "Many Mainers are aware of the dangers of Lyme disease, which can lead to meningitis, encephalitis and sometimes heart blockage" (37).
Lyme disease cases are increasing in Maine	Tick counts, and Lyme disease transmission is increasing, or expected to increase in Maine (either for humans or dogs) Mentions tick expansion of range, higher case counts.	"Ticks can carry diseases such as Lyme disease, which has been increasing in caseload in Maine over the past two decades" (166). "Lyme disease skyrocketed in Maine in 2019, reaching a record of at least 2,079 cases and eclipsing the previous high of 1,852 cases in 2017" (80). "There were ticks when I was a kid, but they weren't this bad, and Lyme disease was much rarer" (432).
Lyme disease is not fully understood by science	Science does not fully understand the risks of infection with Lyme disease. Includes any uncertainties surrounding the disease, such as unknown level of threat,	"There are a few physicians who believe very strongly in this diagnosis of chronic Lyme disease," said Dr. David McDermott, president of the Maine Medical Association. "But there are many others who doubt it exists, including the vast majority of physicians who specialize in infectious diseases" (1).

	consequences, and impacts of the disease itself. Include messages that refer to debates within medical field. Do not include messages of testing	"Scientists still have much to learn about tickborne diseases…" (80). "However, veterinarians are not as certain how to help cure dogs of the widespread disease, particularly in advanced stages. "If you ask 10 vets, you get 11 options," Mitchell said. "It's true there isn't any scientific proof to support any of the common treatments. We're kind of left to our own good judgment"" (185). "Some physicians may disagree with Lyme prophylaxis, but I think an educated public should have that option" (242). "The bacterium that causes Lyme may also be sexually transmitted. Sadly enough, U.S. Centers for Disease Control and Prevention and Infectious Diseases Society of America guidelines do not mention this." (385).
Mentions demographic that has higher/highest likelihood of contracting Lyme	Children, elderly, etc.	"Higher infection rates of tick-borne diseases occur in children aged two to 14, making young campers prime targets for ticks – and tick prevention." (33)
No or limited countermeasures	Messages that state there is no human vaccine or treatment available. Messages that state there is no way to guarantee avoiding exposure.	"A vaccine for Lyme disease was discontinued in 2002; no vaccine is available today" (3). "There's a problem with how we manage Lyme disease," Pfeiffer said in a recent phone interview. "People need to be aware that we have a long way to go before we get to the point where we can adequately diagnose and treat Lyme disease and other tick-borne diseases." (12)
Other TBD present in Maine are anaplasmosis, babeosis, Powassan virus	Besides Lyme disease, it is also possible to contract other tick-borne diseases from the black-legged tick in the state of Maine. These include anaplasmosis, babesiosis, Borrelia miyamotoi disease, and Powassan encephalitis.	"Anaplasmosis, another disease transmitted to humans by the deer tick, emerged as a threat in 2017, with a record 400 cases reported through October" (182). "In addition to the dreaded and debilitating Lyme disease, Maine has seen a surge in babesiosis, anaplasmosis and Powassan encephalitis" (433).
Pets can get infected with Lyme/other TBD	It is possible for a dog or other pet to contract a tick-borne disease such as Lyme from the bite of an infected tick	"If a dog seems lethargic, appears lame or is not interested in eating, he could have Lyme disease" (174).
Prevention tactics are controversial or may cause	Bug spray may include harmful chemicals, tucking in pant legs is not appealing, etc.	"Tuck your long pants into your socks, experts recommend. OK, it's nerdy. But it'll mean ticks can't crawl…" (280). "…number one item on the list was "remove leaf litter." Leaves provide a great year-round home for ticks, protecting

problems if conducted	Deer population management and spraying may be controversial.	them from excessive heat, cold and dryness. Remove the leaves and you'll have fewer ticks. Makes sense. The city's official newsletter, however, has been urging residents to "Leave the Leaves!" and directs them to a website that implores us not to rake, blow, shred or bag the leaves in our yards, citing many benefits for birds, bees, butterflies and other backyard critters." (433)
Tick control efforts are not effective	Prevention tactics or control measures that are implemented to control ticks are not possible or are not effective. Include messages that say that ticks cannot be controlled, therefore the risk cannot be controlled. Also include messages that state that possible control efforts are not being implemented.	"Pinette said that because research to find a safe vaccine or a botanical lawn spray that kills ticks is inconclusive.." (99) "With spring's warmer weather comes a familiar menace: ticks and their associated diseases such as Lyme. Yet despite the widespread prevalence of Lyme, and the misery it's caused, there is still not enough information about how to combat it on a large scale" (83).
Transmission is widespread in Maine	Messages that mention that it is possible to contract Lyme equally all throughout the state. Do not include messages that specify differentiations in risk levels (i.e. messages that state that transmission is high in southern Maine would be coded as the risk minimizing code).	"WHERE ARE TICKS FOUND? In every county in Maine and both urban and rural communities" (185). "The deer tick that carries Lyme disease is now distributed statewide" (244).
Travel to areas with potential Lyme disease transmission is not safe	Walking off the trail, in tall grasses, or through leaf litter increases one's exposure to ticks. Specifically includes messages that discuss areas that increase one's risk/exposure potential.	
You can get Lyme disease from a black-legged (deer) tick	Ixodes scapularis, the black-legged (deer) tick is responsible for spreading Lyme disease to humans.	"Lyme disease is caused by a bacterial infection transmitted by the bite of a deer tick." (80). "Ticks can carry diseases such as Lyme disease, which has been increasing in caseload in Maine over the past two decades." (166)
You can get Lyme without getting bit by an infected tick	Lyme disease can be contracted without a tick bite. One can get Lyme disease through sex.	"The bacterium that causes Lyme may also be sexually transmitted…There is also evidence that newborns can be born with tick-borne illnesses." (385).

	One can be born with Lyme.	

2) Risk minimizing messages

Code	Definition	Example
Efforts are underway to reduce the risk of ticks and Lyme disease	Messages that mention prevention methods that are **not** at the individual level (such as town spraying), Include messages of educating the public on risks of ticks and Lyme Specific examples Language on legislative action/plans to fund tick research No language regarding testing for disease	"The Maine CDC has organized events in recognition of National Lyme Disease Awareness Month, including programs at L.L. Bean and Cabela's, a poster contest for elementary students and an audio contest for high school and college students" (23). "… a new law passed by Congress, the TICK Act, co-sponsored by U.S. Sen. Susan Collins, R-Maine, will be a great help in the future for researchers to do more comprehensive field surveillance of ticks in Maine, and improve diagnostics so that more people are tested for the disease." (121) "Because of the increase, the Maine CDC is offering more educational seminars this year to help prevent the spread of the disease." (107). "Some communities, such as Falmouth and Portland's Peaks Island, are removing Japanese barberry." (182).
Efforts are underway to test ticks for disease	Messages that mention testing available for tick identification or testing ticks for pathogens Recommends individuals to submit ticks for testing, either for tick or disease identification.	"The $15 test for tick-borne pathogens will continue to be available to the public for 2020. In addition, the public can send ticks to the lab for free identification, a service that the lab has offered for several years." (44). "Ticks found on humans or pets can be sent to Maine Medical Center Research Institute's Vector-borne Disease Laboratory for identification." (336).
Infection can be prevented by performing a tick check	Checking yourself for ticks during and/or after recreating is an essential step to reduce one's risk of experiencing a tick bite, therefore reducing the risk of an infection of Lyme disease. Tick checks can be accomplished by showering.	"Showering immediately after spending time outside will help to spot and remove unattached ticks. Bath time is the perfect time for a child to carefully inspect themselves for any unwanted hitchhikers" (33). "When you get home, do a tick check" (107). "With the increasing incidence of Lyme disease, Mainers should be in the habit of doing tick checks after frequenting tick territory" (220).
Infection can be prevented by putting clothes in dryer	The risk of tick bites can be limited by the heat of a dryer killing ticks that may remain on one's clothes.	"…place any untreated dirty clothes in a resealable bag until the clothes can be put in a dryer on high heat for 15 to 30 minutes, which will kill any ticks." (33).

		“Another precaution: Throw the clothes you've worn outside in the dryer for 15 minutes on high heat. The dryer kills ticks, he said” (280).
Infection can be prevented by tucking pants into socks	Pants that are tucked into one’s socks can reduce the likelihood of getting bit by a tick.	"Tuck your pant legs into your socks" (280).
Infection can be prevented by wearing bug spray	The use of deet (permethrin), or bug spray of any kind can repel ticks, therefor the risk of getting infection from a tick is reduced. Include messages that refer to all-natural spray and natural oils	“Ticks can be prevented by wearing repellent and covering exposed skin while outdoors.“ (166) “Use repellent” (336). “But with humans, there might be some hope for rosemary oil. "Maine Medical Center is looking at it both as a repellent and as a spray to actually kill the ticks”” (251).
Infection can be prevented by wearing long, light colored clothes	The use of cloth that covers the skin such as long sleeves and pants that are tucked into one’s socks can reduce the likelihood of getting bit by a tick. One should wear light colored clothing to easier spot a tick.	“Wear long-sleeved shirts and pants. Tuck your pants legs inside your socks. Wear light-colored clothing so it's easier to see ticks.” (107) “"Wear light-colored clothing. It's easier for you to see ticks," Dill said” (280).
Infection in pets can be prevented with preventative treatment	The risk of tick bites in pets can be limited with a vaccine. The risk of tick bites in pets can be limited with preventative treatments (pills, drops, etc.) The risk of infection can be reduced by performing tick checks on pets	“… many veterinarians are suggesting that dog owners invest in both a canine Lyme vaccine and some form of tick preventative treatment year round.” (100). “Flea and tick preventative treatments, which repel and kill ticks, come in many forms. There are topical solutions (liquid applied to the dog's back), oral medications (usually taken once a month) or collars.” (100). “Just as people should check themselves for ticks, pet owners should check their dogs for ticks when they come inside” (174). “…and checks his three cats and dogs by feeling, not just looking” (68).
Lyme disease can be treated	There are treatments available to those who have been infected with Lyme disease.	“Oral antibiotics are used to treat Lyme and anaplasmosis” (3). “…unlike Lyme disease, which is a bacterial infection that can be treated with antibiotics” (52). If caught early, the infection can be treated with antibiotics.” (80). “Treatment for Lyme disease is most effective if begun early.” (107)

Not every tick carries Lyme	Not every tick bite results in Lyme Not every tick is a carrier of Lyme (black-legged versus dog tick).	"Only a minority of deer tick bites lead to Lyme disease." (107). "…more than 50 percent of deer ticks – sometimes more than 65 percent – carry Lyme disease in Maine." (42) "Conservatively, an average of 50 percent of Maine deer ticks carry disease, Elias said." (3).
Personal efforts to minimize risk at landscape level	Messages that indicate there are steps individuals can take to reduce the risk of tick exposure on their own property, such as personal spraying, mowing, cleaning up of leaf litter, etc.	" One method uses a bait box to lure mice inside, where a small wick treated with the pesticide fipronil "lightly brushes the mouse, gently applying a very small amount," the website states. …Studies have shown this approach leads to a 60-80 percent decrease in ticks after one year, and a 90-100 percent reduction after two years…" (93) "Another device attracts white-tailed deer with a bin of corn. As the deer snack, their "ears, heads, necks, and shoulders rub against vertical rollers that are treated with acaricide. Through grooming, the deer also transfer the acaricide to other parts of their bodies," the website states." (93) "Even raking leaves can help prevent Lyme." (182). "Cut back plantings around the foundation of your home. "Heavy foliage actually harbors deer ticks quite nicely," Dill said" (251).
Serious adverse events occur in a limited number of infected	Idea that Lyme can be easy to treat if caught early Only few individuals with Lyme disease experience serious consequences, mentions only mild symptoms	"In the vast majority of cases that are detected early, people are treated with a course of antibiotics and recover fully" (1). "About 25% of anaplasmosis patients are hospitalized, compared to about 5% of Lyme patients. The treatment —a course of antibiotics for a bacterial infection —is similar for anaplasmosis and Lyme" (83).
Transmission is not widespread in Maine	Messages saying that the risk of Lyme disease in Maine is low, that there is low risk of contracting Lyme disease. Transmission is limited to one part of the state, such as southern Maine.	"Ticks are less of a problem in northern counties and at higher elevations, but that could change with a gradually warming climate" (3). "The deer tick (Ixodes scapularis) is a small tick mostly inhabiting the coastal areas of York and Cumberland Counties." (220).

3) Guidance Messaging

Code	Definition	Example
Climate change is responsible for the increase in ticks	Many messages about climate change, warmer weather, shorter winters. explicit reference to climate change, not just warming weather for example	"Researchers say climate change could factor into escalation of Lyme disease, anaplasmosis" (121). "A federal report released last week said climate change could bring warmer winters that make diseases like Lyme more prevalent" (247). "The prospect of a warming climate in northern Maine, or even just more mild winters, bodes well for ticks, which are thought to be expanding northward in the U.S. and Canada." (8)
Guidance on recreating with pets	Keep dog on leash to avoid going off trail.	"Chaplin suggests dog owners be wary or at least aware of the diseases that can be contracted outside, and the remedies. The outdoor risks can be decreased by vaccines for tick-borne diseases such as Lyme and anaplasmosis…" (106).
Guidance on where to recreate	Messages that advise people, provide recommendations to stay on trail, out of tall grass, away from leaf litter. Include messages of where *not* to recreate.	"Avoid interfaces of grassy areas and woods." (107). "However, people should be especially careful when in the following areas: Wooded, forested sites. Wild, unmaintained landscapes with tall grass. Brush or leaf piles" (185).
Mentions environmental conditions that impact tick	Messages that indicate that climatic conditions can impact the tick population and potentially the correlating risk of exposure to Lyme.	"For instance, the hot and dry summer of 2018 may have contributed to reduced Lyme disease cases, while in 2019 Maine experienced a more wet and humid summer, Dill said. Ticks thrive in damp and humid conditions." (121) "The rapid speed at which Lyme disease cases were being reported this spring seems to have slowed, probably due to the dry and hot summer conditions…" (331) "Sears said this spring we had a banner "crop" of ticks because of three warm seasons leading up to it: a warm fall last year, a mild winter and a very warm spring." (331)
Mentions guidelines for how to remove a tick	Mentions tick spoon, tweezers, rotating motion, importance of removing complete body of tick, ensuring the head gets removed. Mention of when to remove tick	"To remove an attached tick, grasp the tick close to the point of attachment and exert a slow and steady pull. The tick will eventually disengage. Disinfect the bite site" (220). "Experts recommend using tweezers to remove a tick from a person or pet" (280). "So if and when you're bitten, remove the tick as soon as possible" (257).

Mentions guidelines for testing	Messages that advise to see doctor or health care provider if an individual experiences a tick bite, has symptoms, or if it believed that they have contracted Lyme disease	"Contact your doctor immediately if you've been bitten and are experiencing symptoms, as treatment is most effective when started early" (3). "If you develop any symptoms or an illness within weeks of a bite, see a health care provider right away" (257).
Mentions guidelines on how to treat the symptoms with modern medicine	Messages that mention what an individual can do to respond to symptoms Use of the word "antibiotics" as a suggestion for treatment	"The good thing is that they can be treated with antibiotics," (39). "The treatment —a course of antibiotics for a bacterial infection —is similar for anaplasmosis and Lyme" (131).
Mentions how long tick needs to be attached to transmit Lyme disease.	Provides information on a time period required for a tick to remain engorged in order for Lyme to spread to a human.	"In most cases, ticks need to be attached to a human for 36 hours before diseases can be transmitted" (42). "While a tick must be attached for 36 to 48 hours to transmit Lyme disease…" (392).
Mentions seasonality	Messages that mention that there are periods of the year when risk of Lyme or tick bites may be higher than other times; mentions specific months or seasons.	"This year's unusually warm winter and early spring mean ticks have become active earlier than usual…" (107). "However, the ticks were not as active in the heat of summer. Ticks normally are most active in the spring and fall when it's cold and damp." (331) "For personal protection, Maine health officials recommend … keeping a watchful eye for the ticks throughout the warm months" (8).
Mentions that alternative forms of medicine can be used to treat Lyme symptoms	Messages that indicate that Lyme disease and/or the resulting symptoms can be treated with natural methods.	"She and her husband Greg began researching alternative medicines, and he suggested she try Gerson therapy, a complex juicing regimen used to treat cancer and other autoimmune disorders. From there she began studying herbal remedies. They looked critically at their lifestyle, transitioned to a GMO-free diet…" (406).
Source of information about the disease	Mentions where the information is coming from. This may be individuals, journals, CDC, etc. If same source is mentioned multiple times in the same article, only code the first appearance of each source.	"Cases of anaplasmosis, which affects white blood cells, have spiked from nine in 2007 to 26 in 2011, according to state epidemiologist Dr. Stephen Sears." (3). "The Maine Center for Disease Control and Prevention cautions people to take tick-prevention measures, such as…" (182). "The CDC recommends the following tips to reduce the risk of disease spread by ticks…" (392).
The increase of ticks can be caused by other	Tick population/risk of TBD increasing due to changes in deer population, changing human activity, etc.	"Many things could be in play, Elias said, including not only temperature, but also humidity in the soil, snow, deer density near people, leaf cover, more people moving into tick habitats by building homes near wooded areas, summer

factors besides climate change.		precipitation, how cold the winters are and the expansion of the Japanese barberry invasive plant.” (182). “Tick encounters have been increasing recently due to more people getting out and enjoying nature…” (220).
The time of year when one can get Lyme disease is changing	Trends of when Lyme disease exposure is possible is changing.	"Lyme disease has tripled in just the first two months of the year," said Dr. Dora Mills, director of the Maine CDC. "I've never heard of ticks in February or March in Maine." (326).

Other recommendations for the use of NVivo

- Save often. Each time you begin a coding session, rename the article with the date and your last name.

APPENDIX B: 2019 ACADIA NATIONAL PARK SURVEY

Start of Block: Block 1

Q12 **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.**

Q13 **What was the primary purpose of your trip?**

- ○ Recreation (1)
- ○ Business trip (2)
- ○ Visiting family or friends (3)
- ○ Just passing through (4)
- ○ I am a permanent resident of the area (5)
- ○ Stay at our seasonal/timeshare residence in Mount Desert Island (7)
- ○ Other *(Please specify)* (8) _____

Q55 **Was this your first visit to Acadia National Park?**

- ○ Yes (1)
- ○ No (2)

Skip To: Q59 If Was this your first visit to Acadia National Park? = Yes

Q56 **In which season do you most often visit Acadia National Park?**

- ○ Spring (1)
- ○ Summer (2)
- ○ Fall (3)
- ○ Winter (4)

Q57 **Why do you prefer to visit Acadia during this season?** *(Please select ALL that apply)*

- ☐ Little or no mosquitoes present (3)
- ☐ Little or no ticks present (7)
- ☐ Off season--not too many visitors (1)
- ☐ This is when I get time off (4)
- ☐ Trees changing (2)
- ☐ Weather (5)
- ☐ Other *(Please specify)* (6) _____

Q59 **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)*

_____

Page Break

Q13 **Which recreational activities did you participiple in during this trip to Acadia National Park?** *(Please select ALL that apply)*

- ☐ Arts or cultural activity (1)
- ☐ Backpacking (2)
- ☐ Biking on carriage roads (3)
- ☐ Biking on park motor roads (4)
- ☐ Bird watching (5)
- ☐ Boating (6)
- ☐ Bus Tour (32)
- ☐ Camping outside the park (7)
- ☐ Camping at Seawall, Backwoods, Isle au Haut, or Wildwoods Stables Campgrounds (8)
- ☐ Canoeing (9)
- ☐ Concert or festival (10)
- ☐ Dining at Jordan Pond House Restaurant (11)
- ☐ Geocaching (12)
- ☐ Going to the beach (35)
- ☐ Fishing (13)
- ☐ Golfing (14)
- ☐ Hiking in a trail-less area (i.e., cross-country) (15)
- ☐ Hiking on trails (16)
- ☐ Kayaking (18)
- ☐ Non-technical mountain climbing (i.e., without using ropes and special gear) (20)
- ☐ Paddleboarding (21)

- [ ] Picking berries (36)
- [ ] Picnicking (33)
- [ ] Sea kayaking (22)
- [ ] Shopping in the park (23)
- [ ] Sightseeing/driving for pleasure (24)
- [ ] Speed hiking (25)
- [ ] Swimming (34)
- [ ] 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)* (37) _____

Carry Forward Selected Choices from "Which recreational activities did you participle in during this trip to Acadia National Park? (Please select ALL that apply)"

Q14 **Which was your primary recreational activity?**

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

- ○ Speed hiking (27)
- ○ Swimming (28)
- ○ Taking horse and carriage ride (29)
- ○ Technical mountain climbing (i.e., using ropes and special gear) (30)
- ○ Trail running (31)
- ○ Viewing wildlife (32)
- ○ Walking on carriage roads (33)
- ○ Walked my dog (34)
- ○ Other *(Please specify)* (35) _____

Page Break

Q15 **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 (14)
- ☐ Acadia Mountain (Ledges) parking area (12)
- ☐ Baker Island (18)
- ☐ Beehive (34)
- ☐ Beech Mountain area (10)
- ☐ Bubble Pond (7)
- ☐ Bubble Rock (6)
- ☐ Cadillac Mountain summit (5)
- ☐ Champlain Mountain (25)
- ☐ Hulls Cove Visitor Center (35)
- ☐ Eagle Lake parking area (8)
- ☐ Echo Lake Beach (11)
- ☐ Islesford Museum (19)
- ☐ Isle au Haut (20)
- ☐ Jordan Pond House and area (4)
- ☐ Otter Cliffs (22)
- ☐ Pretty Marsh Picnic area (16)
- ☐ Sand Beach (9)
- ☐ Sargent Drive (24)
- ☐ Schoodic Peninsula (17)
- ☐ Schooner Head (31)

- [ ] Seawall area (21)
- [ ] Sieur de Monts area (Wild Gardens, Nature Center, Abbe Museum) (1)
- [ ] Thomson Island picnic area (33)
- [ ] Thunder Hole (3)
- [ ] Valley Cove area (13)
- [ ] Western Mountain Road (15)
- [ ] Wildwood Stables (28)
- [ ] Other *(Please specify)* (32) _____

Q16

Page Break

Q61 **During this trip, which <u>trails</u> 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) (1)
- ☐ Beachcroft and Champlain South Ridge (summit trail) (18)
- ☐ Beech Mountain and South Ridge Loop (lake and forest trail) (8)
- ☐ Beehive Loop (summit trail) (19)
- ☐ Cadillac Mountain North Ridge (summit trail) (28)
- ☐ Cadillac Mountain South Ridge (summit trail) (20)
- ☐ Canada Cliffs Loop (lake and forest trail) (9)
- ☐ Dorr Mountain South Ridge Loop (summit trail) (21)
- ☐ Eagle Lake and Conners Nubble Trail (lake and forest trail) (29)
- ☐ Flying Mountain Loop (coastal trail) (7)
- ☐ Giant Slide Loop (summit trail) (22)
- ☐ Gorham Mountain Loop (coastal trail) (2)
- ☐ Great Meadow Loop (lake and forest trail) (10)
- ☐ Great Head Trail (coastal trail) (3)
- ☐ Gorge and A Murray Young Path Route (lake and forest trail) (11)
- ☐ Jesup Path and Hemlock Road Loop (lake and forest trail) (12)
- ☐ Jordan Cliffs Loop (lake and forest trail) (13)
- ☐ Jordan Pond Path (lake and forest trail) (14)
- ☐ Long Pond and Great Notch Trail (lake and forest trail) (30)
- ☐ Norumbega Mountain Loop (lake and forest trail) (15)
- ☐ North Bubble Loop (lake and forest trail) (16)

- [ ] Ocean Path (coastal trail) (4)
- [ ] Pemetic Mountain Loop (summit trail) (24)
- [ ] Penobscot and Sargent Mountain Loop (summit trail) (23)
- [ ] Perpendicular and Razorback Loop (lake and forest trail) (17)
- [ ] Precipice Loop (summit trail) (25)
- [ ] Saint Sauveur and Acadia Mountain (summit trail) (26)
- [ ] Ship Harbor Trail (coastal trail) (5)
- [ ] Triad Trail (summit trail) (31)
- [ ] Wonderland Trail (coastal trail) (6)
- [ ] Other *(Please specify)* (27) _____

Page Break

End of Block: Block 1

Start of Block: Block 2

Q18 **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.**

Q54 **Do you know what a tick is?**

- ○ Yes (1)
- ○ Maybe (2)
- ○ No (3)

Skip To: End of Block If Do you know what a tick is? = No

Q19 **The following statements talk about ticks. Please select the option that best reflects your knowledge.**

	Yes (1)	**No** (2)	**Don't Know** (3)
A ticks' life cycle lasts 3 months (6)	○	○	○
All types of ticks cause diseases to humans (4)	○	○	○
During the summer, the chance of tick bites is higher compared to the winter (2)	○	○	○
Ticks mostly fall out of trees (3)	○	○	○
Ticks wait in shrubs/tall grasses (8)	○	○	○

Page Break

Q20 **Which of the following diseases are <u>transmitted by ticks</u> in Maine?** *(Please select ALL that apply)*

	Yes (1)	**No** (2)	**Don't know** (3)
Anaplasmosis (2)	○	○	○
Babesiosis (5)	○	○	○
Dengue (6)	○	○	○
Lyme disease (1)	○	○	○
Powassan Virus (4)	○	○	○
West Nile Virus (3)	○	○	○

Page Break

Q62 **The following statements talk about Lyme disease. Please select the option that best reflects your knowledge.**

	Yes (1)	**No** (2)	**Don't Know** (3)
People can get Lyme disease after a tick bite (1)	○	○	○
Ticks are born infected with the pathogen that causes Lyme disease (2)	○	○	○
Ticks get infected with the pathogen that causes Lyme disease from biting people who are infected with Lyme disease (3)	○	○	○
Ticks get infected with the pathogen that causes Lyme disease from biting mice and other small mammals that are infected with the disease (4)	○	○	○

Q63 **In which of the following <u>types of habitats</u> are ticks that carry Lyme disease more likely to be found in Maine?** *(Please select ALL that apply)*

	Very Likely (1)	**Likely** (2)	**Neither** (3)	**Unlikely** (4)	**Very Unlikely** (5)
Gravel (8)	○	○	○	○	○
Hardwood forests (7)	○	○	○	○	○
Paved roads (5)	○	○	○	○	○
Rocks (6)	○	○	○	○	○
Softwood forests (2)	○	○	○	○	○
Tall grass (4)	○	○	○	○	○
The beach (3)	○	○	○	○	○
Wood chips (1)	○	○	○	○	○

Page Break

Q65

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

	Strongly Agree (1)	**Agree** (2)	**Somewhat Agree** (3)	**Neutral** (4)	**Somewhat Disagree** (5)	**Disagree** (6)	**Strongly Disagree** (7)
I am afraid of ticks (1)	○	○	○	○	○	○	○
I am disgusted by ticks (2)	○	○	○	○	○	○	○
I worry about Lyme disease (3)	○	○	○	○	○	○	○
Lyme disease would have a negative impact on my life (4)	○	○	○	○	○	○	○
I believe Lyme disease is difficult to cure (5)	○	○	○	○	○	○	○
I think Lyme disease is a serious condition (6)	○	○	○	○	○	○	○
I think there is a great chance that I will contract Lyme disease after a tick bite (7)	○	○	○	○	○	○	○
I am at risk of contracting Lyme disease when recreating outdoors (8)	○	○	○	○	○	○	○

Having an outdoor pet increases my risk of contracting Lyme disease (9)	○	○	○	○	○	○	○

Page Break

Q66

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

	Very Effective (1)	Effective (2)	Neutral (3)	Not That Effective (4)	Not at All Effective (5)
Examining yourself for ticks and removing them after being outdoors (i.e. a tick check) (1)	○	○	○	○	○
Exercising regularly (2)	○	○	○	○	○
Thoroughly washing hands before eating (3)	○	○	○	○	○
Wearing long pants and long sleeved shirts when recreating outdoors (4)	○	○	○	○	○
Wearing gaiters in wooded areas (5)	○	○	○	○	○
Tuck pants into socks in wooded areas (6)	○	○	○	○	○
Staying on pathways in wooded areas (7)	○	○	○	○	○
Using insect repellent (8)	○	○	○	○	○
Healthy eating habits (9)	○	○	○	○	○
Avoiding wooded areas (10)	○	○	○	○	○
Putting pesticides on property (11)	○	○	○	○	○
Wearing sunscreen when spending time outside (12)	○	○	○	○	○

Taking a shower or bath after being in a wooded area (13)	○	○	○	○	○
Regularly mowing the lawn on your property (14)	○	○	○	○	○
Removing or sweeping the leaf litter on your property (15)	○	○	○	○	○
Putting up barriers to exclude deer on your property (16)	○	○	○	○	○

Q67 **How often do you practice/use the following precautionary behaviors to prevent ticks**

	Always (1)	Usually (2)	Sometimes (3)	Never (4)
Perform tick checks after being outside (1)	○	○	○	○
Wear insect repellent (2)	○	○	○	○
Wear protective clothing (such as long pants and long-sleeved shirts) (3)	○	○	○	○
Tuck pants into socks (4)	○	○	○	○

Page Break

Q68

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neutral (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
Wearing protective clothing during the summer is too warm (1)	○	○	○	○	○	○	○
There is a low chance of getting bit by a tick (2)	○	○	○	○	○	○	○
Wearing protective clothing in nature is excessive (3)	○	○	○	○	○	○	○
There is a low chance of getting Lyme disease (4)	○	○	○	○	○	○	○
Too little information is available on its usefulness (5)	○	○	○	○	○	○	○
The cost of purchasing new clothing is too high (6)	○	○	○	○	○	○	○
It is bothersome (7)	○	○	○	○	○	○	○
It is unpleasant to do (8)	○	○	○	○	○	○	○
I normally forget (9)	○	○	○	○	○	○	○

It is too time consuming (10)	○	○	○	○	○	○	○

Q69

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
My degree of disgust of ticks (1)	○	○	○	○	○	○	○
My degree of fear of ticks (2)	○	○	○	○	○	○	○
The severity of Lyme disease (3)	○	○	○	○	○	○	○
The extent to which I am at risk of being bitten by a tick when I visit nature (4)	○	○	○	○	○	○	○
The benefits wearing protective clothing can yield, like not getting Lyme disease (5)	○	○	○	○	○	○	○
How good I feel about myself when I wear protective clothing (6)	○	○	○	○	○	○	○
The high chance of getting bit by a tick (7)	○	○	○	○	○	○	○
Expert suggestions (8)	○	○	○	○	○	○	○
Wearing protective clothing prevents me from getting Lyme disease (9)	○	○	○	○	○	○	○

The benefits of wearing protective clothing are more important to me than the inconvenience it may cause (10)	○	○	○	○	○	○	○

Q70

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
People whose opinion I value will appreciate it if I wear protective clothing (1)	○	○	○	○	○	○	○
People whose opinion I value will disapprove if I wear protective clothing (2)	○	○	○	○	○	○	○
People whose opinion I value wear protective clothing while visiting nature (3)	○	○	○	○	○	○	○
Wearing protective clothing is important to me (4)	○	○	○	○	○	○	○
After wearing protective clothing I feel good about myself (5)	○	○	○	○	○	○	○

Page Break

Q71

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
Tucking my pants into my socks during the summer is too warm (1)	○	○	○	○	○	○	○
There is a low chance of getting bit by a tick (2)	○	○	○	○	○	○	○
Tucking pants into socks is excessive (3)	○	○	○	○	○	○	○
There is a low chance of getting Lyme disease (4)	○	○	○	○	○	○	○
Too little information is available on its usefulness (5)	○	○	○	○	○	○	○
I don’t like the way it looks (6)	○	○	○	○	○	○	○
Not effective (7)	○	○	○	○	○	○	○
I do not know how to do it effectively (8)	○	○	○	○	○	○	○
It is bothersome (9)	○	○	○	○	○	○	○

It is unpleasant to do (10)	○	○	○	○	○	○	○
I normally forget (11)	○	○	○	○	○	○	○
It is too time consuming (12)	○	○	○	○	○	○	○

Q72

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
My degree of disgust of ticks (1)	○	○	○	○	○	○	○
My degree of fear of ticks (2)	○	○	○	○	○	○	○
The severity of Lyme disease (3)	○	○	○	○	○	○	○
The extent to which I am at risk of being bitten by a tick when I visit nature (4)	○	○	○	○	○	○	○
The benefits tucking my pants into my socks can yield, like not getting Lyme disease (5)	○	○	○	○	○	○	○
How good I feel about myself when I tuck my pants into my socks (6)	○	○	○	○	○	○	○
The high chance of getting bit by a tick (7)	○	○	○	○	○	○	○
Expert suggestions (8)	○	○	○	○	○	○	○
Tucking my pants into my socks prevents me from getting Lyme disease (9)	○	○	○	○	○	○	○

The benefits of tucking my pants into my socks are more important to me than the inconvenience it may cause (10)	○	○	○	○	○	○	○

Q73

How much do you agree or disagree with the following statements about <u>tucking pants into your socks</u> to

prevent tick bites/Lyme disease?

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
People whose opinion I value will appreciate it if I tuck my pants into my socks (1)	○	○	○	○	○	○	○
People whose opinion I value will disapprove if I tuck my pants into my socks (2)	○	○	○	○	○	○	○
People whose opinion I value tuck their pants into their socks while visiting nature (3)	○	○	○	○	○	○	○
Tucking my pants into my socks is important to me (4)	○	○	○	○	○	○	○
After tucking my pants into my socks I feel good about myself (5)	○	○	○	○	○	○	○

Page Break

Q74

How much do you agree or disagree with the following statements about BARRIERS to <u>using insect repellent</u> to prevent tick bites/Lyme disease

	Strongly agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
There is a low chance of getting bit by a tick (1)	○	○	○	○	○	○	○
There is a low chance of getting Lyme disease (2)	○	○	○	○	○	○	○
I do not believe it is effective (3)	○	○	○	○	○	○	○
Do not like to use insect repellent products for my skin (4)	○	○	○	○	○	○	○
Using insect repellent skin products is excessive (5)	○	○	○	○	○	○	○
I am not familiar with insect repellent skin products (6)	○	○	○	○	○	○	○
It is bothersome (7)	○	○	○	○	○	○	○
It is unpleasant to do (8)	○	○	○	○	○	○	○
I normally forget (9)	○	○	○	○	○	○	○

It is too time consuming (10)	○	○	○	○	○	○	○

Q75

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
My degree of disgust of ticks (1)	○	○	○	○	○	○	○
My degree of fear of ticks (2)	○	○	○	○	○	○	○
The severity of Lyme disease (3)	○	○	○	○	○	○	○
The extent to which I am at risk of being bitten by a tick when I visit nature (4)	○	○	○	○	○	○	○
The benefits using insect repellant can yield, like not getting Lyme disease (5)	○	○	○	○	○	○	○
How good I feel about myself after using insect repellent (6)	○	○	○	○	○	○	○
The high chance of getting bit by a tick (7)	○	○	○	○	○	○	○
Expert suggestions (8)	○	○	○	○	○	○	○
Using insect repellent prevents me from getting Lyme disease (9)	○	○	○	○	○	○	○

The benefits of using insect repellent are more important to me than the inconvenience it may cause (10)	○	○	○	○	○	○	○

Q76

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
People whose opinion I value will appreciate it if I use insect repellent (1)	○	○	○	○	○	○	○
People whose opinion I value will disapprove if I use insect repellent (2)	○	○	○	○	○	○	○
People whose opinion I value use insect repellent while visiting nature (3)	○	○	○	○	○	○	○
Using insect repellent is important to me (4)	○	○	○	○	○	○	○
After using insect repellent I feel good about myself (5)	○	○	○	○	○	○	○

Page Break

Q77

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
There is a low chance of getting bit by a tick (2)	○	○	○	○	○	○	○
There is a low chance of getting Lyme disease (3)	○	○	○	○	○	○	○
Checking my skin after being outdoors is excessive (4)	○	○	○	○	○	○	○
I do not know how to recognize a tick (5)	○	○	○	○	○	○	○
I do not know how to remove a tick (6)	○	○	○	○	○	○	○
There is a low chance of getting Lyme disease (8)	○	○	○	○	○	○	○
I do not think it is effective (9)	○	○	○	○	○	○	○
It is bothersome (10)	○	○	○	○	○	○	○
It is unpleasant to do (11)	○	○	○	○	○	○	○
I normally forget (12)	○	○	○	○	○	○	○

It is too time consuming (13)	○	○	○	○	○	○	○

Q78

How much do you agree or disagree with the following statements about your MOTIVATIONS to <u>performing a tick check</u> to prevent tick bites/Lyme disease

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree nor Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
My degree of disgust of ticks (1)	○	○	○	○	○	○	○
My degree of fear of ticks (2)	○	○	○	○	○	○	○
The severity of Lyme disease (3)	○	○	○	○	○	○	○
The extent to which I am at risk of being bitten by a tick when I visit nature (4)	○	○	○	○	○	○	○
The benefits performing a tick check can yield, like not getting Lyme disease (5)	○	○	○	○	○	○	○
How good I feel about myself after performing a tick check (6)	○	○	○	○	○	○	○
The high chance of getting bit by a tick (7)	○	○	○	○	○	○	○
Expert suggestions (8)	○	○	○	○	○	○	○
A tick check is an effective way to prevent Lyme disease (9)	○	○	○	○	○	○	○

The benefits of doing a tick check are more important to me than the inconveniences it may cause (10)	○	○	○	○	○	○	○

Q79

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

	Strongly Agree (1)	Agree (2)	Somewhat Agree (3)	Neither Agree or Disagree (4)	Somewhat Disagree (5)	Disagree (6)	Strongly Disagree (7)
People whose opinion I value will appreciate it if I perform a tick check (1)	○	○	○	○	○	○	○
People whose opinion I value will disapprove if I perform a tick check (2)	○	○	○	○	○	○	○
People whose opinion I value perform tick checks after visiting nature (3)	○	○	○	○	○	○	○
Performing a tick check is important to me (4)	○	○	○	○	○	○	○
After performing a tick check I feel good about myself (5)	○	○	○	○	○	○	○

Page Break

Q31 **Concern about tick borne disease has caused me to:**

	Strongly Agree (1)	**Agree** (2)	**Somewhat Agree** (3)	**Neutral** (4)	**Somewhat Disagree** (5)	**Disagree** (6)	**Strongly Disagree** (7)	**Does Not Apply** (8)
Change my feelings about wildlife (6)	○	○	○	○	○	○	○	○
Change the types of outdoor activities I conduct (9)	○	○	○	○	○	○	○	○
Change the times of year that I recreate outdoors (5)	○	○	○	○	○	○	○	○
Change the times of day that I recreate outdoors (10)	○	○	○	○	○	○	○	○
Change the locations where I recreate outdoors (8)	○	○	○	○	○	○	○	○
Increase personal protection activities when recreating outdoors (7)	○	○	○	○	○	○	○	○
Keep my family out of tick-prone areas (3)	○	○	○	○	○	○	○	○
Reduce my outdoor activity (4)	○	○	○	○	○	○	○	○
Stop recreating outdoors (2)	○	○	○	○	○	○	○	○

Other *(Please specify)* (12)	○	○	○	○	○	○	○	○

Page Break

Q64 **What do you do when finding a tick on yourself or family member?** (Please select ALL that apply)

- ☐ Burn tick off with a match (5)
- ☐ Leave tick on until a doctor removes it (11)
- ☐ Remove tick using nails (6)
- ☐ Remove tick using oil (1)
- ☐ Remove tick using tick spoon (4)
- ☐ Remove tick using tweezers (2)
- ☐ Rub alcohol on tick to remove it (9)
- ☐ Unscrew tick to remove it (10)
- ☐ Use nail polish to remove tick (7)
- ☐ Use petroleum-based gel to remove tick (8)
- ☐ Other (*Please specify*) (3) _____

Page Break

Q32 **Of the following, which factors would you say are causing the greatest increase in ticks?**

	Strongly Agree (1)	**Agree** (2)	**Somewhat Agree** (3)	**Neutral** (4)	**Somewhat Disagree** (5)	**Disagree** (6)	**Strongly Disagree** (7)
Available tick habitat (5)	○	○	○	○	○	○	○
Climate change (1)	○	○	○	○	○	○	○
Human development of landscapes (4)	○	○	○	○	○	○	○
Increased rodent populations (3)	○	○	○	○	○	○	○
Overabundant white-tailed deer (2)	○	○	○	○	○	○	○
Not sure (6)	○	○	○	○	○	○	○
Other *(Please specify)* (7)	○	○	○	○	○	○	○

Q33 **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)*

	Myself (1)	**Close Family Member** (2)	**Close Friend** (3)	**Family Pet** (4)
Anaplasmosis (2)	☐	☐	☐	☐
Babesiosis (3)	☐	☐	☐	☐
Ehrlichiosis (6)	☐	☐	☐	☐
Lyme disease (1)	☐	☐	☐	☐
Powasan virus (5)	☐	☐	☐	☐
Other *(Please specify)* (4)	☐	☐	☐	☐

Page Break

Q34 **Did you find ticks while visiting Acadia National Park?**

- ○ Yes (5)
- ○ No (6)

Display This Question:
If Did you find ticks while visiting Acadia National Park? = Yes

Q35 During this visit, which regions of the park did you find ticks at? *(Please select ALL that apply)*

- ☐ Beech Mountain (7)
- ☐ Blackwoods Campground (8)
- ☐ Cadillac Mountain (5)
- ☐ Echo Lake (6)
- ☐ Hull's Cove (1)
- ☐ Jordan Pond (3)
- ☐ Sand Beach (4)
- ☐ Seawall Campground (10)
- ☐ Sieur de Monts (2)
- ☐ Other (11) _____
- ☐ Not Sure (12)

Page Break

Q51 **During this visit, did you obtain any information about ticks and tick borne diseases?**

- ○ Yes (1)
- ○ No (2)

Display This Question:
If During this visit, did you obtain any information about ticks and tick borne diseases? = Yes

Q52 **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) (10)
- ☐ Other website (11) _____
- ☐ Brochures by Acadia National Park (5)
- ☐ Chamber of Commerce/Visitor Bureau/State Welcome Center (13)
- ☐ Friends/Family/Word of mouth (8)
- ☐ Hotel/campground (14)
- ☐ Interpretive Signs at Acadia National Park (4)
- ☐ Lifeguard (2)
- ☐ Newspapers/Magazines (6)
- ☐ Park Ranger (1)
- ☐ Park Service Bulletin Boards (3)
- ☐ Shopkeeper (16)
- ☐ Television/Radio Programs/Videos (9)
- ☐ Travel Guides/Tour Books (such as AAA, Lonely Planet, etc.) (7)
- ☐ Other (*Please specify*) (15) _____

Page Break

End of Block: Block 2

Start of Block: Block 3

Q37 **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.**

Q38 **Are you male or female?**

- ○ Male (1)
- ○ Female (2)
- ○ Other (4)
- ○ Prefer not to answer (6)

Q39 **What is your age (in years)?**

_____

Q41 **What is the highest level of school you have completed?**

- ○ Grade 8 or lower (1)
- ○ Some high school, no diploma (2)
- ○ High school diploma or equivalent (3)
- ○ Some college, no degree (4)
- ○ Associate degree (5)
- ○ Bachelor's degree (6)
- ○ Master's degree (7)
- ○ Professional degree (8)
- ○ Doctorate degree (9)

Q42 **Which category best represents your annual household income?**

- Less than $24,999 (1)
- $25,000 to $34,999 (2)
- $35,000 to $49,999 (3)
- $50,000 to $74,999 (4)
- $75,000 to $99,999 (5)
- $100,000 to $149,999 (6)
- $150,000 to $199,999 (7)
- $200,000 or more (8)

Page Break

Q44 **What ethnicity/race(s) do you consider yourself?** *(Please select ALL that apply)*

- ☐ American Indian or Alaska Native (1)
- ☐ Asian (2)
- ☐ Black or African-American (3)
- ☐ Hispanic (6)
- ☐ Native Hawaiian or other Pacific Islander (4)
- ☐ White (5)

Q45 **What language is most frequently spoken in your home?**

- ○ English (1)
- ○ Other (2) _____

Q46 **When it comes to politics, you generally consider yourself to be:**

- ○ Very Liberal (1)
- ○ Liberal (2)
- ○ Basically Independent, But Leaning Toward Liberal (3)
- ○ Independent (4)
- ○ Basically Independent, But Leaning Toward Conservative (5)
- ○ Conservative (6)
- ○ Very Conservative (7)

Q47 **Have you visited a National Park Service site before today?**

- ○ Yes (1)
- ○ No (2)

Q48 **On this visit, what kind of personal group (not guided tour/school group) are you with?**

- ○ Alone (1)
- ○ Family (2)
- ○ Friends (3)
- ○ Family and friends (4)
- ○ Others *(Please specify)* (5) _____

Page Break

Q49 **Which of the following best describes your residency on Mount Desert Island, Maine?**

- ○ Permanent Resident (1)
- ○ Summer Resident (returning annually for 1-6 months) (2)
- ○ Not a Resident (3)

Q50 **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.**

_____

Q80 **Are ticks and tick-borne diseases a concern where you live?**

- ○ Yes (5)
- ○ No (6)

Q51 **Please provide any final comments you may have about ticks and tick-borne diseases.**

_____
_____
_____
_____
_____

Page Break

Q50 **Please enter your personal identification code to avoid receiving unnecessary reminders.**

_____

Page Break

Q52

Please hit submit if you are ready to finalize your survey responses If you are interested to learn more about ticks and tick-borne diseases, we have included three links with information on diseases caused by ticks, tick prevention, and Lyme disease: Tick borne diseases: http://www.ticksinmaine.com/diseases Tick Prevention: http://www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/tick-messaging.shtml Lyme Disease: https://www.cdc.gov/lyme/

Thank you for participating in this study!

Q51

If you would like to enter your name into our L.L.Bean gift card raffle, please click the link below and enter a mailing or email address.

https://umaine.qualtrics.com/jfe/form/SV_cuxc6D715NRRcdD

End of Block: Block 3

APPENDIX C: INVIATION TO PARTICIPATE IN RESEARCH

Dear Acadia National Park Traveler,

You are invited to participate in a research project being conducted by Dr. Sandra De Urioste-Stone, an assistant professor at the University of Maine. The purpose of this study is to better understand what visitors know about ticks and tick-borne diseases. Because each participant will represent many others who will not be studied, your input is extremely important. You must be at least 18 years of age to participate. What will you be asked to do? If you decide to participate, you will be asked to fill out the following questionnaire, which will take approximately twenty minutes.

Risks: Except for your time, there are no risks to participate in this study.

Benefits: While this study may have no direct benefit to you, this research will help us learn more about the knowledge that visitors have about ticks and tick-borne diseases. This information will be useful in long-term planning and park management decisions.

Compensation: Upon completion of the survey, you will have the opportunity to enter your name into a raffle for one of three $50 L.L. Bean gift cards.

Confidentiality: Your responses for the survey will be 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 type your name anywhere on the questionnaire. The data will be stored on a secure electronic database and the key will be stored using software that provides additional security. The electronic key will be destroyed in January 2021. The Qualtrics database will be maintained until September 2026; aggregate data will be kept indefinitely.

Voluntary: Participation is voluntary. You may stop 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, Assistant Professor
School of Forest Resources, University of Maine
(207) 581-2885, sandra.de@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 of 207/581-2657 (or email umric@maine.edu)

Thank you for taking the time to complete this questionnaire!

BIOGRAPHY OF THE AUTHOR

MacKenzie Conant was born in suburban Massachusetts but likes to think of herself as being raised in the western mountains of Maine where her family now resides. She attended the University of Maine in Orono to pursue Forestry but quickly switched to Parks, Recreation and Tourism. She worked as an undergraduate research assistant in the Human Dimensions of Natural Resources Lab and graduated in three years with a Bachelor of Science with a concentration in Nature-Based Tourism and minor in Marketing. She will be continuing her career in the field of Wilderness and Visitor Use Management with the Department of the Interior as she transitions to the Bureau of Land Management. She is a candidate for the Master of Science degree in Forest Resources from the University of Maine in August 2024.