RECREATIONAL SPECIALIZATION AMONG MICHIGAN SNOWMOBILERS: DIFFERENTIATION, RISK PERCEPTION, AND GEOGRAPHIC INTERACTION

By

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ABSTRACT

RECREATIONAL SPECIALIZATION AMONG MICHIGAN SNOWMOBILERS: DIFFERENTIATION, RISK PERCEPTION, AND GEOGRAPHIC INTERACTION

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Snowmobiling is an integral part of Michigan's tourism economy with over two million snowmobile use days annually. The extensive designated snowmobile trail system and abundant snowfall have attracted passionate snowmobilers who travel long distances and stay overnight. The theoretical construct of recreational specialization was applied to understand the within-group social world of the snowmobilers. To foster safer riding experiences and reduce the number and severity of snowmobiling accidents, snowmobilers' perceptions of key riding risks were examined by looking at the effect of levels of specialization on the perception of risk. The spatial interaction between snowmobilers' residential origin and snowmobiling destination was also investigated to better understand the association between recreational specialization and spatial interaction.

A total of 807 research subjects came from a statewide survey of Michigan snowmobile trail permit purchasers in the winter of 2007-08. Daily snow precipitation for the winter of 2007-08 and Michigan snowmobile trail GIS shapefiles were also utilized. Summative indices and cluster analysis were applied to segment different snowmobile subgroups. One-way ANOVA, effect size Eta, coupled with a gravity model and spatial statistics were applied to investigate the relationships among snowmobilers' within-group social world, their perception of risks, and spatial interaction with the snowmobile trail network.

The results showed that Michigan snowmobilers were heterogeneous, with distinct behavioral, skill/knowledge, and psychological attachment characteristics. Some became more specialized in snowmobiling and spent increasingly more time and money on the activity. Others focused on different aspects of snowmobiling such as trail riding or conspicuous consumption, once they acquired enough snowmobiling experience. Recreational specialization did not effectively predict perception of risks as Michigan snowmobilers perceived similar threats in all nine hazardous riding stimuli. While expert snowmobilers perceived significantly lower risk on "Speed of snowmobile," novice snowmobilers underestimated the risk of "Cars/trucks on seasonal roads." Neither did recreational specialization explain snowmobilers' spatial interaction with snowmobiler trail network. Some minimal to moderate associations were found between snowmobilers travel from region to region. While Michigan's Upper Peninsula attracted expert snowmobilers from the Lower Peninsula, the northern Lower Peninsula was the favorite destination for intermediate snowmobilers.

Key managerial recommendations from the analysis of this data include establishing a mandatory snowmobile training course; more robust mechanisms of disseminating snowmobile information; establishing a voluntary safety patrol program; creating a digital profile for snowmobile accidents involving personal injury or fatality; and more comprehensive snowmobile marketing strategy for residents and visitors.

This Doctoral dissertation is dedicated to my family.

The sincere gratitude to my loving father, Ei-Kwang, Wu and mother, Chi-Fang, Huang for their devotion and endless support that made this seven lonely years of study abroad possible. My sister, Hsing-Yin, Wu, a talented animator, who always gives me courage and laughter, helped me sail through much difficult time along the way. My baby brother, Che-An, Wu, an earnest man, reminds me of myself 10 years younger, whose passion and determination always inspire me to work harder.

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Introduction

Background Information

Snowmobiling is a flourishing outdoor activity that involves a motor-driven vehicle traveling on snow and ice for transportation or recreational purposes. Since the early 1970s, millions of Americans have participated in snowmobiling and manufacturers have developed increasingly sophisticated machines, increasing speed, comfort, fuel economy, and safety. In 2012, the International Snowmobile Manufacturers Association (ISMA; 2013) reported that there were a total of 1.4 million registered snowmobiles in the United States (U.S.). The economic impact brought on by the activity is estimated at 22 billion dollars annually in the U.S. The state of Michigan, with 216,144 registered snowmobiles in 2012, is the third largest snowmobile market in the U.S. just trailing Minnesota and Wisconsin.

Michigan is one of the few states in the nation that offers a large system of interconnected snowmobile trails. As of July 2013, there are 6,200 miles of designated snowmobile trail in Michigan. Most of them are located in the Upper Peninsula and the northern and western Lower Peninsula because of the availability of public land and deeper snowpack (See Figure 1 for current Michigan snowmobile trail network). These trails are usually groomed regularly by local snowmobile clubs to ensure riding safety and enjoyment. These extensive snowmobile trails penetrate through multiple state forests, three national forests, and many acres of privately owned lands, which provide abundant opportunity to mingle with nature (Michigan Department of Natural Resource, 2013). The long-distance snowmobile trail network and abundant snow precipitation has made Michigan an excellent environment for snowmobiling.

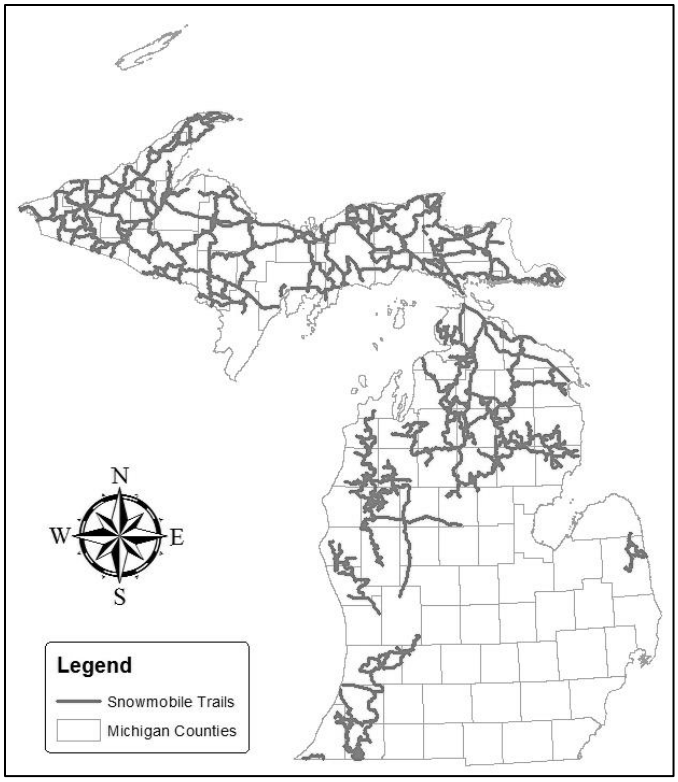

Figure 1 Michigan Snowmobile Trail Network
Data source: Michigan DNR

Snowmobiling is a unique outdoor recreation. It relies almost exclusively on natural snowfall. Riding a snowmobile to view scenery, interact with nature, and experience the excitement of rapid travel over a snow covered landscape, as well as the opportunity to socialize with other snowmobilers are the main purposes of such winter outdoor activity. Many other outdoor enthusiasts, such as anglers, hunters, and boaters, travel to a destination for the activity and stay within a relatively smaller geographic area. Snowmobilers, because modern snowmobile can travel long distance at a high speed, typically ride extensive distances on a linear trail that may be more than 100 miles long and connects with other trails. For a day trip, snowmobilers on average travel 30 to 75 miles within a favorite riding area or on a trail. For a touring style overnight trip, the distance of travel normally ranges between 100 and 150 miles per day (ISMA, 2013). Nelson and his colleagues (2009) studied Michigan snowmobiling trip

characteristics and found that 45% of the trips involved overnight stays, 12% were day trips 100 miles and more from home, and 43% were day trips traveling less than 100 miles from home. According to ISMA (2013), more than half of the snowmobilers (53%) trailer their snowmobiles to a destination region for riding, while the rest begin their trips from their primary residence or a vacation home. Although the trail network is unevenly distributed across Michigan and mostly distant from major metropolitan areas, passionate snowmobilers are still willing to travel long distances or take an overnight trip to enjoy this unique winter recreation.

In Michigan, all snowmobiles riding on public lands, including the snowmobile trail system and frozen water, must have a Michigan snowmobile trail permit permanently affixed to the forward half of the snowmobile directly above or below the headlight, regardless of registration in Michigan or another state. There were 199,592 snowmobile trail permits sold during the winter of 2008-09. Those snowmobilers generated a total of 2,046,547 snowmobile days in Michigan (Nelson, Wu, Stynes, & McCarty, 2009). It is also reported that these snowmobilers spent an estimated 251 million dollars on trips to Michigan in the 2007-08 winter season (Stynes, 2009). Snowmobiling is one of the most popular winter outdoor recreation activities and an integral part of the state's economy.

However, study of the social aspect of snowmobiling is limited (Lynch, 2000; Nelson et al., 2009). The theoretical framework of recreational specialization has been applied to study the within-group social world of many different outdoor recreation activities (Manning, 2011; Scott, Ditton, Stoll, & Eubanks, 2005). Through a more profound analysis, recreational specialization reveals how recreationists' behavioral and psychological involvement changes over time.

Recreation planners and managers may be more informed in their managerial decisions through an increased awareness of the diversity of snowmobilers.

Accompanying the maturity of the industry is concern about snowmobiling risks and the rising number of accidents. It is reported that more than 200 people are killed and an additional 14,000 people are injured each year in North America due to snowmobile-related accidents (Pierz, 2003). Because of its interaction with natural terrain and the sensation seeking nature, snowmobiling has been included in the scope of adventure tourism (Buckley, 2010). Risk, the major component of adventure tourism, has been well documented in the literature (Buckley, 2012; Ewert, 1989; Weber, 2001). Adventure tourism is therefore often referred to its broader term, risk recreation. One of the most frequently cited definitions of adventure tourism encapsulates the characteristics of snowmobile riding:

> … often commercialized and involving an interaction with the natural environment away from the participant's home range and containing elements of risk; in which the outcome is influenced by the participant, setting, and management of the touristic experience (Weiler and Hall, 1992, p. 143)

While snowmobilers look for thrill and enjoyment, outdoor recreation managers aim to reduce the number and severity of accidents through regulations, law enforcement, education, and trail design and maintenance.

In Michigan, key laws and rules to reduce accidents and their severity relate to equipment requirements, operator age limits, riding location, and the specific focuses on avoiding alcohol use and speeding. Riding tips and regulation brochures are easily accessible online and in each Department of Natural Resources (DNR) service center. In addition, snowmobile safety

education training is required for youth ages 12 to 17 and is recommended for all snowmobile operators. Nevertheless, the sensation-seeking activity has taken 633 lives (30.1 fatalities annually) in Michigan between 1992 and 2013 (Figure 2; Michigan DNR, 2008, 2009, 2010, 2011, 2012, and 2013). Although the annual number of fatalities has substantially decreased due to the intensified enforcement efforts initiated in the late 1990s (Lynch, 2000), limited patrol cannot fully cover the extensive landscape. The ultimate goal of preventing fatal snowmobile accidents becomes challenging.

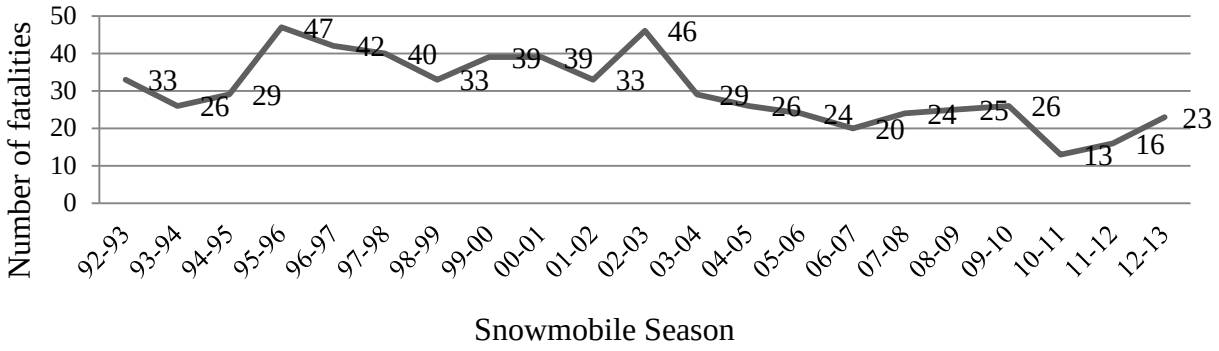

Figure 2 Trends of Michigan Snowmobile Fatalities
Data source: Michigan DNR, 2008, 2009, 2010, 2011, 2012, and 2013

To move forward to effectively prevent snowmobile accidents, lessons from research in motor vehicle accidents are useful. Snowmobile riding is very similar to automobile operation given that both activities involve critical driving skills such as overtaking, time estimation, and hazard detection (Deery, 1999; Leung & Starmer, 2005). Especially, when dealing with traffic accidents, the ability of detecting and recognizing potential traffic hazards plays a key role in preventing accidents (Deery, 1999). One paradigm of such research has focused on drivers/riders' risk perception.

Risk perception is defined as "the subjective experience of risk in potential traffic hazards" (Deery, 1999, p. 226). It is "the process of identifying hazardous objects and events and quantifying their dangerous potential." Risk perception is considered a precursor of actual driving behavior (Machin & Sankey, 2008). When a driver considers an object or event is dangerous enough to jeopardize his/her wellbeing, the driver perceives a certain level of risk. Once the driver perceives a high level of risk, he/she may take action to avoid the potential hazard. Hatfield and Fernandes (2009) concluded that a high level of perceived risk is therefore associated with a lower chance of having an accident. Conversely, if one does not believe a risky behavior is harmful, he/she is likely to engage in the risky driving behavior, which increases the probability of accident occurrence. With this in mind, exploring snowmobilers' risk perceptions will help further knowledge of how they make judgments when encountering potential hazards and eventually achieve the purpose of accident reduction and prevention.

Problem Statement

Previous research viewed snowmobilers as one homogeneous group when studying their personal characteristics, snowmobile behaviors, and attitudes toward management and law enforcement initiatives (Lynch, 2000; Nelson et al., 2009; Stewart & Black, 2004). However, these studies also revealed that snowmobilers are heterogeneous, given that a range of experience and behavioral involvement were exhibited. An in-depth analysis using recreational specialization is warranted to further not only the academic understanding of these outdoor enthusiasts, but also to provide pragmatic knowledge to inform policy and managerial decisions.

Further, though previous studies have examined the relationships between recreational specialization and various attitudinal variables (Dyck, Schneider, Thompson, & Virden, 2003;

Smith, Burr, & Reiter, 2010), the perception of risk has not been assessed using recreational specialization as an independent variable. While prior snowmobile accident studies concluded that young snowmobilers were the predominant victims, research also suggested that those cited for snowmobile law violations snowmobiled more days and traveled more miles than those not cited for violations (Lynch, 2000). Whether experienced or novice snowmobilers tend to underestimate risk is unclear. Since the construct of recreational specialization reflects recreationalists' experience and skill level, it may provide a complex but solid measurement tool in explaining different perceptions of risk.

Finally, while it may be true that recreational specialization provides rational explanation for within-group diversity, what happens during the developing process of recreational specialization remains unclear. In the last decade, recreational specialization research has shifted its focus from how participants' behaviors and attitudes vary among specialization levels to the process and development of recreational specialization (Kuentzel & Heberlein, 2006; Oh, Sorice, & Ditton, 2010; Scott & Lee, 2010). The focus on the behavioral and psychological change in the specialization process ignores the external factor of how resource availability and accessibility influence leisure behavior. The context within which recreational activity takes place has not been taken into consideration (Giles-Corti & Donovan, 2002). This is especially true when abundant snowfalls and available lands are critical elements to snowmobile riding. Furthermore, since Michigan's snowmobile trail network is unevenly distributed across the state, each snowmobiler's accessibility to snowmobiling opportunities differs depending on where they live and how far they are willing to travel. Both resource availability and accessibility should be integrated into one model for the purpose of investigating the effect of these external factors on the development of snowmobilers' recreational specialization. By measuring the spatial

interaction between origins and destination, thereby taking resource availability and accessibility into account, a gravity model can be utilized to study how external environmental factors affect leisure behavior. No previous research has examined the relationship between recreational specialization and recreationists' spatial interaction with recreation opportunity. To effectively address this knowledge deficit, a spatial analytic method using Geographic Information System (GIS) is applied. With this spatial technology, the process and development of recreational specialization can be further investigated.

Research Objectives

There are three research objectives of this study.

1. Describe and compare recreational specialization among Michigan snowmobilers.
2. Examine the influence of recreational specialization on Michigan snowmobilers' perception of risk.
3. Assess the relationships between Michigan snowmobilers' recreational specialization and their spatial interaction with Michigan's snowmobile trail network.

Research Questions

To address the three research objectives, this study asks:

1. What are the behavior, skill/knowledge, and psychological attachment characteristics of snowmobilers in different levels of specialization?
2. What are the relationships between levels of recreational specialization and snowmobilers' perception of risk?
3. What are the relationships between levels of recreational specialization and snowmobilers' spatial interaction with the snowmobile trail network?

Conceptual Framework and Null Hypotheses

Recreational specialization, perception of risk, and spatial interaction are three concepts studied in this research. A conceptual framework of this research which utilized Michigan snowmobiler as research subjects to examine the interaction between three concepts is illustrated in Figure 3.

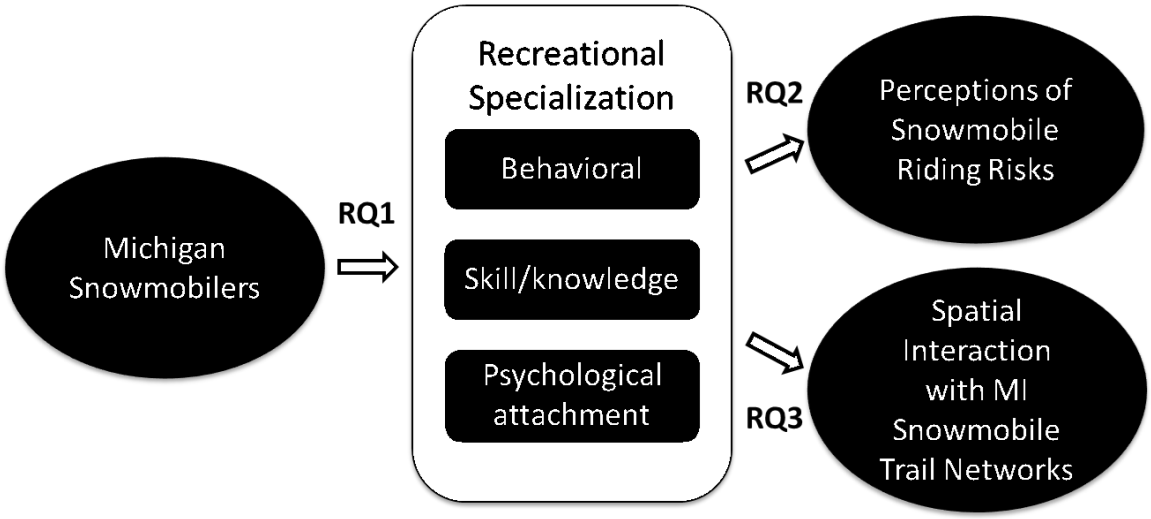

Figure 3 Conceptual Framework

Recreational specialization has not been used to empirically examine snowmobilers. The use of this theoretical framework to represent different dimensions of participation provides potential for an improved assessment of snowmobiling involvement. Previous specialization research has demonstrated distinct behavioral, skill/knowledge, and psychological attachment characteristics between each sub-group for various outdoor activities. Similar results are conceivable for Michigan snowmobilers. Summative indices and cluster analysis are two prevailing methods in classifying levels of specialization in a recreational activity. A limited number of studies have applied both methods to examine a single group of recreationists (Scott et al., 2005). Whether summative indices or cluster analysis is an appropriate segmentation

approach for Michigan snowmobilers is unclear. Therefore, to compare recreational specialization among Michigan snowmobilers, this research proposes the null hypothesis:

H_1: There is no difference in group composition between levels of specialization using summative indices and cluster analysis.

Further, previous literature has confirmed the relationships between recreational specialization and several attitudinal aspects of recreation participation, such as attitude toward managerial actions and perception of pro-environmental programs. While the traffic literature has concluded that young and novice drivers tend to underestimate risk and are most likely to be in accidents, a Michigan snowmobile study found that those who violate snowmobile laws tend to ride significantly more miles and spend more money on the activity than average snowmobilers (Lynch, 2000). Lynch's study also suggested that those snowmobile law violators perceived lower risk on multiple potential hazardous stimuli such as speed of snowmobiles, drinking while snowmobiling, snowmobiling on roadways, and the presence of other vehicles on seasonal roads. Therefore, it is foreseeable that a certain relationship exists between snowmobilers' recreational specialization and their perception of risk. Lynch's (2000) list of nine snowmobile riding scenarios was adopted for measuring snowmobilers' perception of risk. The nine item list includes: operation of snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol); operation of snowmobile by a legally intoxicated person (0.08 or higher blood alcohol); speed of snowmobile; driver lacking skill in operating machine; cars/trucks on seasonal roads; public trail conditions; public trail design; other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing); and snowmobiling on

county/state road shoulders. Since the relationship between recreational specialization and the perception of risk is unclear, nine null hypotheses are proposed:

H_2: There is no relationship between snowmobilers' recreational specialization and their perception of operating a snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol).

H_3: There is no relationship between snowmobilers 'recreational specialization and their perception of operating a snowmobile by a legally intoxicated person (0.08 or higher blood alcohol).

H_4: There is no relationship between snowmobilers 'recreational specialization and their perception of speed of snowmobile.

H_5: There is no relationship between snowmobilers 'recreational specialization and their perception of driver lacking skill in operating machine.

H_6: There is no relationship between snowmobilers 'recreational specialization and their perception of cars/trucks on seasonal roads.

H_7: There is no relationship between snowmobilers 'recreational specialization and their perception of public trail conditions.

H_8: There is no relationship between snowmobilers 'recreational specialization and their perception of public trail design.

H_9: There is no relationship between snowmobilers ’recreational specialization and their perception of other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing).

H_{10}: There is no relationship between snowmobilers ’recreational specialization and their perception of snowmobiling on county/state road shoulders.

Research has suggested that leisure participation is substantially affected by the availability of recreation opportunities (Fesenmaier & Lieber, 1985). Improved access to a recreation area results in increased visitation and an expansion of the market area. Distance decay literature has also shown that the degree of spatial interaction (movement between residential origin and destination) is inversely related to distance. Since the level of recreational specialization measured is heavily based on recreationists’ leisure participation, the level of specialization of each snowmobiler is assumed to be correlated to the spatial interaction with snowmobile trail network. Consequently, to assess the relationships between snowmobile specialization and their spatial interaction with the snowmobile trail network, this research proposes the null hypothesis:

H_{11}: There is no relationship between levels of recreational specialization and snowmobilers’ spatial interaction with the snowmobile trail network.

Research Significance

In studying Michigan snowmobiling, the research significance is three-fold:

First, applying recreational specialization theory to categorize snowmobilers provides in-depth insights into effective management practices from both social and behavioral aspects.

Through this study of behavior, skill/knowledge, and psychological attachment characteristics, recreation program managers can discover new user trends, implement marketing plans, develop policies and managerial strategies, and bring in potential revenue. From a research perspective, comparing and contrasting two commonly used statistical grouping methods, summative indices and cluster analysis, not only contributes to the advancement of recreational specialization theory but also enhances the validity and robustness of analysis. Most previous research often employed either summative indices or cluster analysis seemingly. This research tests both methods and selects the appropriate approach to best represent the characteristics of Michigan snowmobilers, and applies the method to answer research questions.

Second, from the lens of snowmobilers' psychological recognition of potential traffic hazards, this research aims to provide evidence to help reduce the incidence and severity of snowmobile accidents. By identifying those snowmobilers who tend to underestimate snowmobiling risks, Michigan DNR, regional managers, and law enforcement can more effectively implement appropriate intervention programs such as rider improvement courses or workshops, riding safety campaigns such as The Safe Rider!, and rules and regulations that target aberrant riding behaviors. From the research standpoint, linking the theory of recreational specialization to traffic research and safety science provides a meaningful taxonomic approach aside from traditional demographic segmentation. Examination of the relationships between recreational specialization and perception of risk expands the literature on how recreational specialization influences characteristics and cognitions of recreationists.

Finally, by exploring the relationship between recreational specialization and snowmobilers' spatial interaction with the snowmobile trail system, this research potentially explains how recreation opportunity affects leisure participation. By investigating the impact of

available and accessible snow and designated trails on snowmobilers' level of specialization, knowledge of how recreationists develop their specialization can be enhanced. In addition, using geospatial technology as a research tool provides alternative view from a geographic dimension in studying human leisure behavior. Building upon few other studies using GIS, this research not only offers an example of applying geospatial statistics to leisure science, but also examines the applicability of the gravity model in measuring spatial interaction between recreation demand and supply. This model may shed light on developing spatial interaction models for other recreation activities, as well as a more complex model in measuring spatial interaction.

Chapter Two

Literature Review

Recreational Specialization

Recreational specialization is the core theoretical framework for this research. A literature review of its original concept, its relationships to multiple behavioral and attitudinal constructs, and measurement is presented below.

Original Concept

Recreational specialization, a theory that was first introduced by Hobson Bryan in 1977, describes the variation of recreationists from the inexperienced to the specialized within a specific outdoor activity. The level of specialization of these recreationists is generally symbolized by their participation history, equipment and skills used, and preferences for recreation setting. As these recreationists move into a more specialized stage over time, their behavior and attitudes change accordingly. Through on-site interviews and observations, Bryan identified four subgroups on the continuum of trout fishermen and discovered that each subgroup differs in attitudes and values about the activity, preferences toward resources and management policy, as well as their social belongings, vacation patterns, and life styles (Figure 4). Recreational specialization is thus suggested to have a 'predictive utility' for other attitudinal and behavioral aspects of recreation participation and can be applied to a variety of other leisure activities (Bryan, 1977; Bryan, 2000).

Recreational specialization was originally developed to account for the heterogeneity of trout anglers within whom Bryan observed distinctly diverse beliefs and norms reflected by their intensity of commitment to the activity (Bryan, 2000). Since its initiation, recreational

specialization has been utilized as a taxonomic approach to segment various outdoor recreation participants. Multiple subgroups of specialization were successfully identified for anglers (Oh & Ditton, 2006), boaters (Kuentzel & Heberlein, 2006), bird watchers (Lee & Scott, 2006), hikers (Shafer & Hammitt, 1995), hunters (Needham, Vaske, Donnelly, & Manfredo, 2007), campers (McFarlane, 2004), and other outdoor recreationists. For adventure recreation, most of the specialization literature focused on whitewater rafting (Bricker & Kerstetter, 2000; Kuentzel & McDonald, 1992), others studied rock climbing (Ewert & Hollenhorst, 1994), mountaineering (Dyck, et al., 2003), surfing (Nourbakhsh, 2008), skiing and snowboarding (Needham & Little, 2013), off-highway vehicle (OHV) riding (Smith et al, 2010) and SCUBA diving (Thapa, Graefe, & Meyer, 2006). None, to the author's knowledge, has ever empirically applied recreational specialization to study snowmobilers. Given that snowmobiling involves riding skill development, significant economic investment, travel time, free time away from work, and club membership, it is conceivable that subgroups of snowmobilers can be identified using the recreational specialization construct. Results will aid in the further understanding of other behavioral and attitudinal aspects of snowmobiling.

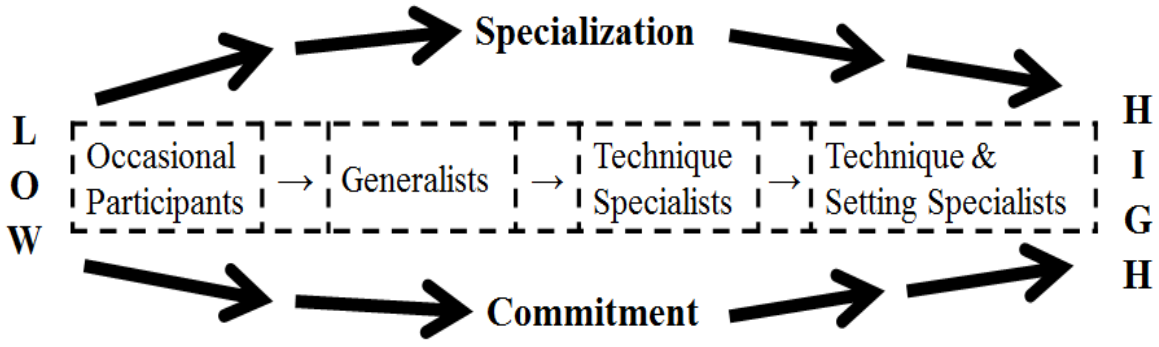

Figure 4 Recreational Specialization Continuum
Adapted from "Commitment and Leisure Behavior: A Theoretical Perspective," by Buchanan, T., 1985, Leisure Science, 7 (4), p.406.

Recreational Specialization and Behavior, Attitude, and Perception

Research has empirically proven that recreational specialization is related to various behavioral aspects of recreation participation, which includes participants' setting preferences, flow experience, information source used, and knowledge learned. Virden and Schreyer (1988) found that recreational specialization is significantly related to the preference of environmental setting attributes among backcountry hikers. Similar conclusions were drawn from studies on vehicle-based campers (McFarlane, 2004), bird watchers (Cole & Scott, 1999; Scott & Thigpen, 2003), and SCUBA divers (Thapa et al., 2006). Serious birders preferred natural bird habitats rather than developed settings, while casual wildlife watchers favored various opportunities for observing wildlife (Cole & Scott, 1999). Meanwhile, as the level of specialization increased, SCUBA divers were less likely to engage in environmentally harmful behaviors and more likely to participate in pro-environmental and educational activities (Thapa et al., 2006). Recreational specialization is also proven to be an effective predictor of flow experience. More specialized mountain hikers were more likely to experience flow than were less specialized mountain hikers (Wöran & Arnberger, 2012). Additionally, a positive relationship was found between recreational specialization and the information used for making trip decisions and the knowledge learned about the activity involved. As level of specialization increased, the quantity of information sources used to make trip decisions increased simultaneously (Cole & Scott, 1999; Ditton, Loomis, & Choi, 1992). Highly specialized skiers and snowboarders were significantly more knowledgeable about an environmental stewardship program at the ski resort than were their counterparts (Needham & Little, 2013). Because of the evidence of behavioral changes as recreationists move from general to specialized, managerial strategies and service were suggested to meet the diverse needs of different subgroups.

Other than behavioral changes, recreational specialization was also found to be associated with various attitudinal aspects of recreation participation. Despite few exceptions (Salz & Loomis, 2005; Smith et al., 2010), findings from the substantial literature generally support Bryan's argument that recreational specialization is positively associated with recreationists' attitude toward environmental restriction and resource protection policies. For example, specialized mountaineers valued the importance of low-impact practices significantly more than less specialized mountaineers (Dyck et al., 2003). Advanced anglers displayed greater appreciation of managerial harvest restriction and were less willing to compromise, while casual anglers preferred loose regulation so they were able to catch more fish (Oh & Ditton, 2006). The pro-environmental attitude also reflected on recreationists' expectation of rewards. As the level of specialization increases, the experience itself becomes more important relative to a physical trophy. More committed river users treasured guaranteed paddling opportunities rather than physical, social and mental outcomes (Kuentzel & McDonald, 1992). Ditton, Loomis, and Choi (1992) also found that it is more important for advanced anglers to enjoy the fishing experience rather than catch lots of fish as the ultimate prize.

Besides environmental concerns, the variation of recreational specialization was found crucially related to the perception of general management actions and other recreationists' behavior. McIntyre and Pigram (1992) studied vehicle-based campers' comments on camp site character and quality of management intervention and distinguished between different specialization levels. The most experienced campers were those with the most critical comments toward facility maintenance and more rigorously resisted policy changes such as an introduction of fees. Recreational specialization also explained how recreationists perceived others' depreciative behaviors. As the level of specialization increased, hikers reported less tolerance for

seeing others, seeing motorized recreationists, and hearing loud recreationists (Virden & Schreyer, 1988). Veteran goose hunters were also more likely to be distracted by other hunters with bad manners than were novice hunters (Kuentzel & Heberlein, 1992). The association between recreational specialization and paddlers' perception of crowding was also tested but no significant linkage found (Kuentzel & McDonald, 1992). Although the existing literature has discovered certain levels of association between the level of recreational specialization and recreationists' various perceptions and attitudes, there has been no published work on the relationship between recreational specialization and perception of risk in snowmobiling.

Recreational specialization was also found to be positively associated with place attachment. Although the overall influence of the level of specialization on place attachment was weak among whitewater river users, specialists were more likely to agree with the importance of place identity and lifestyle component of place attachment than novice river users, while place dependence was not influenced by the level of specialization (Bricker & Kerstetter, 2000). Oh, Lyu, and Hammitt (2012) found that the skill-and-knowledge and commitment dimensions of recreational specialization were positively associated with place identity among fishing license holders. Needham and Little (2013) also found a significant positive correlation between specialization and place attachment among skiers and snowboarders.

Recreational Specialization Measurements

In the past 35 years, studies have emphasized developing a recreational specialization index to represent within group variation. Although little consensus exists on the specific indicators and their dimensions, researchers generally agreed a multi-dimensional model of behavior, skill/knowledge, and psychological attachment to the activity to measure recreational specialization (Lee & Scott, 2004; McIntyre & Pigram, 1992; Scott & Shafer, 2001). Early

literature focused on using behavioral and attitudinal aspects of participation to measure specialization. Two dimensions appeared in Bryan's (1977) original construct, behavior reflected by equipment and skills used, and attitude governed by beliefs and preferences. Donnelly, Vaske, and Graefe (1986) followed Bryan's construct, developing a specialization index using four dimensions to study paddlers' behaviors: previous participatory experience, equipment owned, skill perceived, and boating-related interests. While critics considered Donnelly and his colleague's measurement "solely in terms of behavior" (Scott & Shafer, 2001, p. 325), a close review of the variables revealed evidence of measurement from skill, knowledge, and psychological attachment dimensions. McIntyre and Pigram (1992) later adapted Little's (1976) three-dimensional specialization loop and proposed a recreational specialization model that includes behavioral, affective, and cognitive measurements, which coincided with the three-dimensional approach proposed by Scott and Shafer (2001). The three-dimensional measurement has been widely applied for measuring recreational specialization. The behavioral dimension usually includes, but is not limited to, indicators such as frequency of participation, equipment used/owned, and financial investment (Bryan, 1977; Jett, Thapa, & Ko, 2009; Needham et al., 2007). The skill/knowledge dimension consists of self-reported skill level and knowledge about the activity (Lee & Scott, 2006; Oh et al., 2012). Centrality-to-life and membership were commonly seen indicators of the psychological attachment dimension (McIntyre & Pigram, 1992; Scott, et al., 2005; Thapa et al., 2006).

Disparities on how to classify levels of specialization exist. Summative indices and cluster analysis are two major approaches for segmenting recreationists (Scott et al., 2005). Bryan defined recreational specialization as "a continuum of behavior from the general to the particular" (Bryan, 1977, p. 175); therefore, early specialization studies tended to treat each

measurement as one factor of the entire index (Donnelly et al., 1986; Dyck, et al., 2003; Kuentzel & McDonald, 1992). All measurements in the index were standardized if multiple levels of measurement (nominal, ordinal, interval and ratio) were involved. Then the aggregated score was deemed continuous and utilized to define the location of a respondent on the specialization continuum for the given activity. Research samples were often evenly divided into two, three, four or more sub-groups thereafter as representing different levels of specialization. The disadvantage of this approach is that it assumes all measurements progress simultaneously and the most specialized recreationists demonstrate the most commitment in all aspects of behavior, skill/knowledge, and psychological attachment. However, research has since found that measurements in different dimensions did not always increase linearly in the same direction (Kuentzel & McDonald, 1992, Needham et al., 2007; Scott, Baker, & Kim, 1999; Scott & Thigpen, 2003). Scott and Shafer (2001) argued that some recreationists "continue to participate in activities on a regular basis and accrue commitments but exhibit little evidence of skill development… other individuals may participate in leisure activities infrequently but demonstrate a high level of skill development and personal commitment" (p. 338). Other researchers turned to cluster analysis for identifying subgroups in the activity (McIntyre & Pigram, 1992; Needham et al., 2007; Scott & Thigpen, 2003), given that cluster analysis provides a multivariate classification with more objective measurement then summative indices.

Cluster analysis is a statistical technique which allows the analyst to search for conceptually meaningful sub-groups where each member in the sub-group shares common characteristics (Pang-Ning, Steinbach, & Kumar, 2006). Cluster analysis does not assume each dimension of specialization co-varies and therefore was suggested to be less biased and more appropriate for segmenting recreationists (McFarlane, 1996; Needham et al., 2007; Scott et al.,

2005). However, one drawback of this method is that those identified sub-groups are treated as categorical data and do not necessarily follow the "continuum" proposed by Bryan (1977). In addition, the number of sub-groups is often arbitrarily decided either by the researcher's subjective judgment or following previous studies for the purposes of comparison. Oh and Ditton (2006) suggested that there is simply not a "sacred" number of sub-groups that would fit all recreational specialization studies.

Despite support from both summative indices and cluster, the literature has shown no superiority between the two aforementioned approaches. Scott and his colleagues (2005) examined the efficacy of recreational specialization in predicting birders' generic motivation using both approaches and found little difference between them. Since both summative indices and cluster analysis have been applied to investigate the relationship between recreational specialization and multiple attitudinal preferences (Needham et al., 2007; Smith et al., 2010), this research will use both methods to segment snowmobiling specialization and compare the results for further analyses.

Perception of Risk

Two pieces of literature were reviewed in this section: the concept and measurement of risk perception, and snowmobile fatalities in Michigan and other areas.

Concept and Measurement

Risk perception, or perceived risk, is the cognitive process of identifying and quantifying potentially harmful objects or events. This concept has been applied mostly in traffic and accident prevention studies to understand risky driving behaviors, defined as "the subjective experience of risk in potential traffic hazards" (Deery, 1999, p. 226). As shown in Figure 5,

previous research concluded that a higher perception of risk (i.e., considering the behavior is highly dangerous) is strongly associated with a lower tendency of engaging in risky behaviors (Curry & Youngblade, 2006; Hatfield & Fernandes, 2009; Machin & Sankey 2008). To prevent and reduce the incidence and severity of snowmobiling accidents, studying operators' perceptions of riding risks provides valuable insights in developing intervention programs, education, and management actions.

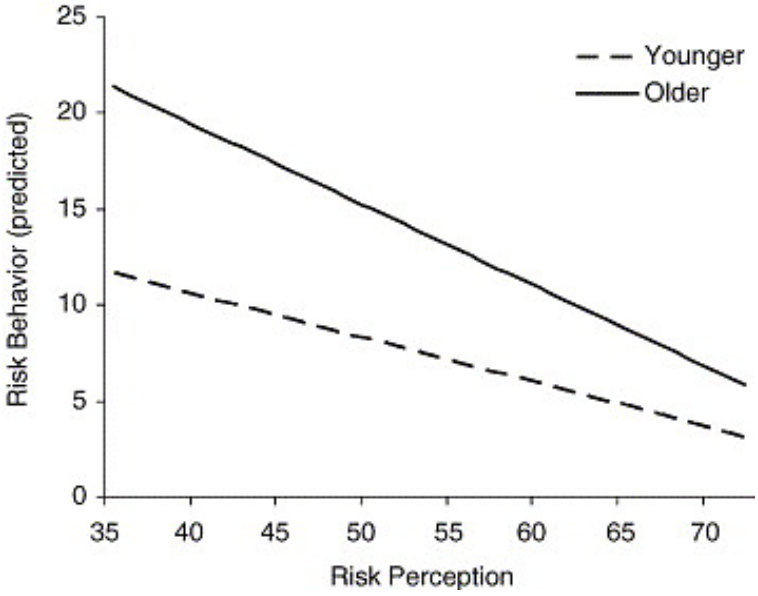

Figure 5 Correlations between Risk Behavior and Risk Perception
Adapted from "Negative affect, risk perception, and adolescent risk behavior," by Curry, L. A. and Youngblade, L. M., 2006, Journal of Applied Developmental Psychology, 27, p.479.

Perception of risk is the attitudinal interpretation of potential hazardous situations or stimulus while snowmobiling. To measure perception of risk, many studies measured the perceived danger of several selected driving actions. For instance, eight risky driving actions (e.g., running a red light, riding a moped without wearing a helmet, etc.) were incorporated by Machin and Sankey (2008) to assess perception of risk. Another eight driving related events such as the likelihood of 'be fined for speeding' and 'have a crash due to drink-driving' were used by Hatfield and Fernandes (2009) to measure the perceived risks. Curry and Youngblade (2006)

measured adolescents' perceptions of risk utilizing a list of six hazardous behaviors such as 'riding in a car with a drunk driver' and 'drinking alcohol.' In the above studies, Likert scales (five or seven points) were adapted in the questionnaires to have respondents rate their perceptions toward the potential hazardous behaviors or events encountered while operating a vehicle. To measure snowmobilers' perception of riding risks, events or conditions that could threaten a snowmobiler's safety should be investigated.

Snowmobile Accidents and Fatalities

For a better understanding of snowmobile accidents and in searching for measurement of snowmobilers' perception of risks, six years of Michigan snowmobile fatality summaries from 2007-08 to 2012-13 were reviewed (Michigan DNR, 2008; 2009; 2010; 2011; 2012; 2013). The fatality summary includes key information on accidents such as victim gender and age, location, cause, possible factors, and a brief description of the accidents. This information provides a profile in identifying potentially hazardous situations or stimulus while snowmobiling.

There were a total of 122 snowmobile accidents resulting in 128 fatalities (21 annually) in the previous six years. This is a decline compared to a total of 319 fatalities (40 annually) for the snow seasons of 1995-96 to 2002-03, due to intensified law enforcement activities such as increased visibility and active inspection (Michigan DNR, 2008; Nelson et al., 2009). Of those 128 fatalities, 102 (80%) were males and 26 (20%) were female. By age, 6% were under 20 years old, 34% were 20 to 39 years old, 49% were 40 to 59 years old, and 11% were 60 years and older. Male snowmobilers between 40 and 59 were the most common snowmobiling fatality victims in Michigan. This is in contrast to several retrospective studies in Minnesota (Beilman et al., 1999), Sweden (Öström & Eriksson, 2002), and Canada (Rowe, Milner, Johnson, & Bota, 1992; Stewart & Black, 2004). These studies concluded that young males in their thirties were

the predominate victims of snowmobile accidents. While the age and gender profile provided an important indication of recognizing those who tend to be involved in snowmobile accidents, it is important to note that there are snowmobilers who do not start snowmobiling until a later stage of their lives. The probability of having a snowmobile accident should be more directly related to the psychological recognition of risk behavior, as well as the familiarity with and the skill of operating and controlling a snowmobile.

The importance of skills and the control of a snowmobile were demonstrated in the fatality reports. Operators losing control of their snowmobiles accounted for at least 77% of the fatal accidents in the past six years, posing major concerns for drivers lacking skills of operating snowmobiles. Failure to negotiate a curve in the road or trail, collision with a snow bank, ejection from the snowmobile, and impact with fixed objects such as trees and steel cables were common scenarios illustrated in the description of accidents (Michigan DNR, 2008; 2009; 2010; 2011; 2012; 2013). Previous studies also suggest that inexperienced riders and unfamiliarity with the environment were important risk factors contributing to snowmobiling accidents (Pierz, 2003). Michigan addresses this concern by providing a safety training course. This management effort mandates that adolescents aged 16 or younger complete the training and earn a safety certification. In addition, this program is recommended but not required for those over 16.

The location of snowmobile fatalities offers additional information in understanding and preventing fatalities. Michigan snowmobilers are allowed to ride on the designated trail system and the right-of-way or shoulders of a public highway in a state/county road system. However, the majority of fatal accidents (43%) occurred on state, county, or seasonal roads; followed by 38% that were on a designated snowmobile trail. Riding on the road shoulders clearly poses challenges since there are other vehicles using the road system at the same time. There were a

number of snowmobiling fatalities caused by the impact of snowmobiles with vehicles on the road system (Michigan DNR, 2011; 2012; 2013). The design of snowmobile trails and trail grooming conditions also deserve attention when searching for factors contributing to snowmobiling fatalities.

Alcohol use and excessive speed have been the major factors directly resulting in snowmobiling accidents. In the past six years, alcohol use was a factor in 45% of fatalities, while excessive speed was involved in 32% of the fatal accidents (Michigan DNR, 2008; 2009; 2010; 2011; 2012; 2013). Another 10 year Michigan snowmobile fatality trend report showed that alcohol/drug use was a factor in 60% of fatalities, while "speed too fast" was involved in 72% of crashes (Michigan DNR, 2003, p.6). Alcohol consumption was also reported to be associated with 44% of snowmobile injuries in Minnesota (Beilman et al., 1999), 70% in Canada (Rowe et al., 1992; Stewart & Black, 2004), and 64% in Sweden (Öström & Eriksson, 2002). With the development of more powerful engines, excessive speed was associated with more than half of snowmobile accidents in Swedan and Canada (Öström & Eriksson, 2002; Stewart & Black, 2004). Local snowmobile clubs and organizations have promoted a "Zero Tolerance" campaign to prevent alcohol use while operating a snowmobile since the early 2000s. In terms of speed, modern snowmobiles are capable of reaching a speed of 90 miles per hour or greater, much faster than the speed limit of 50 miles per hour regulated within the states of Minnesota and Wisconsin. Michigan requires snowmobilers to follow various speed limits posted along the designated trail system. Alcohol use and the speed of snowmobile certainly are two key foci of prevention and intervention programs.

Snowmobilers' riding skill, location of accidents, speeding, and alcohol use were the risk factors directly associated with Michigan snowmobile fatalities, according to the review of

fatality summaries. A list of nine snowmobiling riding scenarios that was used by Lynch (2000) for assessing snowmobilers' perception of risks covered the factors identified in the summaries. The nine item list includes: operation of snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol); operation of snowmobile by a legally intoxicated person (0.08 or higher blood alcohol); speed of snowmobile; driver lacking skill in operating machine; cars/trucks on seasonal roads; public trail conditions; public trail design; other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing); and snowmobiling on county/state road shoulders. Given its comprehensive nature, this list is considered appropriate for measuring Michigan snowmobilers' perceptions of risk.

Spatial Interaction

Three pieces of the spatial interaction literature were reviewed in this section: the general construct of spatial interaction, its application to different fields, and the calibration and measurement of the spatial interaction between Michigan snowmobilers and the trail network.

General Construct

Spatial interaction is a generalized representation of flows of activity, such as the movement of people, capital, freight, or information, between locations. Three basic conditions are necessary for the realization of a spatial interaction to occur: complementarity, no intervening opportunity, and transferability (Rodrigue, Comtois, & Slack, 2013). Complementarity describes the supply and demand relationships between origin and destination. Spatial interaction occurs when snowmobilers (demand) travel from their origins to a destination for services provided by DNR's snowmobile trail system (supply). No intervening opportunity means there are no alternative locations of supply or demand to hinder the spatial interaction between current origin and destination. If Michigan snowmobilers chose to travel to Wisconsin instead of Michigan for

snowmobiling, there will not be a spatial interaction between snowmobilers and Michigan's snowmobile trail network. Finally, transferability is the linkage between origin and destination where the flows of activity actually occur. For Michigan snowmobilers, transferability is represented by the transportation infrastructure between their residential origin and destination. The highway or road system represents the transferability of spatial interaction. To quantify spatial interaction, research has been done seeking approaches to measure and model spatial interaction.

The theoretical basis for modeling spatial interaction in geographical spaces is Newton's laws of motion. Newton's second law of motion provides an explanation for the force existing between two bodies and how the attributes of two bodies contribute to the force. Essentially, the force between two bodies is calculated as the product of two masses divided by the square of the distance between them (Batty, 2007). Early social physicists believed that this physical law can be analogized to spatial interaction models for explaining social phenomena (Witt & Witt, 1995). The gravity model is one such widely accepted model for quantifying spatial interaction.

One of the early attempts in developing the gravity model was by Isard and Bramhall in the 1960s. The basic assumption of the gravity model is that 'the interaction between any two populations can be expected to be directly related to their size; and … inversely related to distance' (as cited in Sen & Smith, 1995, p.1). Following this intuitive assumption, many researchers proposed their own versions of the gravity model by replacing population size with other parameters of the location, or replacing distance with other means of friction such as travel cost or travel time between origin and destination (e.g., Anderson, 1979; Baxton, 1979; Cheung, 1972). To keep the most flexibility and include different factors that affect the measure of the

force between locations, a more general expression of this gravity model was proposed by many authors (e.g., Hua & Porell, 1979; Sen and Sööt, 1981):

$$T_{ij} = A(i)B(j)F(d_{ij})$$

Where T_{ij} is the spatial interaction between origin i and destination j, $A(i)$ is the unspecified parameter associated with the origin i, $B(j)$ is the unspecified parameter associated with the destination j, and $F(d_{ij})$ is the unspecified distance deterrence function between origin i and destination j. The magnitude of spatial interaction is essentially based on three factors: the attributes of the origin, the attributes of the destination, and the friction of separation between origin and destination (Rodrigue et al., 2013). To assess the spatial interaction between Michigan snowmobilers and the snowmobile trail network, this research adapted the gravity assumption and incorporated the attributes of and the spatial friction between origins and destinations that were associated with Michigan snowmobiling.

Application of the Gravity Model

Given its intuitiveness and flexibility, the gravity model has been utilized to model spatial accessibility to locations of supply, migration, and international trade in various disciplines. The gravity model has also been applied in the field of leisure studies. For instance, in assisting tourism planning, Lee, Choi, Yoo, and Oh (2013) integrated a gravity model into the evaluation of the spatial tourism interaction between Korean rural villages for assisting managerial decision making and marketing strategies. Zhang, Lu, and Holt (2011) integrated a gravity model in the development of a more intuitive population-weighted distance to model the potential spatial accessibility to parks. Khadaroo and Seetanah (2008) investigated the role of tourism infrastructure in tourism flows among 28 countries and found that transport infrastructure is a

significant determinant of tourism inflows into a destination. Utilizing a more sophisticated gravity model, Kim and Fesenmaier (1990) examined the effects of spatial structure of recreation opportunity on recreational travel. A competitive and agglomerative relationship was found between nearby recreation opportunities. Parks within a 25 mile travel distance appeared to compete for visitor preference, while the number of nearby parks, when considered a cohesive unit, positively related to visitation with the increase of distance. All these studies altered the gravity assumption based on the purposes and nature of their studies and incorporated attributes and friction associated with the origins and destinations focused on.

Spatial Interaction Measurements

In the review of previous studies, the gravity model was generally utilized for either modeling or measuring spatial interaction between locations. While the regularity and flexibility of the gravity model enables wide application in different domains, criticisms of and debates about the appropriate calibration of destination/origin attributes and friction parameters seldom agree, even more so when estimating the algebraic forms between parameters (Sen & Smith, 1995). The majority of the gravity model literature therefore focused on modeling spatial interaction, in other words, the emphasis was on estimating the parameters and the mathematic functions of different attributes and the friction parameters in searching for the model that fit the best (Sugiyama, Francis, Middleton, Owen, & Giles-Corti, 2010; Witt & Witt, 1995). Using the observed flow measurement (e.g., actual visitation or tourism arrivals), the function of destination/origin and friction parameters, and the algebraic functions were calculated using linear modeling techniques (e.g., Baxter & Ewing, 1986; Keum, 2010; Khadaroo & Seetanah, 2008). A series of more sophisticated gravity models other than the generalized model such as the singly constrained model and doubly constrained entropy-maximizing model were suggested

(Baxter & Ewing, 1986; Wilson, 1967). Other calculation processes such as the two-step floating catchment area (2SFCA) method or enhanced 2SFCA (E2SFCA) were proposed to improve the accuracy of modeling spatial accessibility to health care supplies (Luo & Qi, 2009; Radke & Mu, 2000). These researchers sought a gravity model that could accurately predict the spatial interaction between locations.

The generalized gravity model was incorporated in many studies for the purpose of measuring spatial interaction. Despite the uncertainty of calibration and algebraic functions between parameters, the gravity model was still regularly utilized because it provides a partial explanation and a starting point for more complex models (Witt & Witt, 1995). Previous studies using a gravity model to evaluate spatial accessibility provide valuable calibration and algebraic functions in measuring spatial interaction between Michigan snowmobilers and the snowmobile trail network. Destination park size and Euclidean distance between origin census block and destination park were used in the gravity model by Zhang, Lu, and Holt (2011) to assess spatial accessibility to neighborhood parks. Attractiveness of the destination and shortest road network distance were utilized by Giles-Corti and Donovan (2002) to assess the environmental determinants of physical activity in Perth, Australia. In assessing spatial accessibility to health services, availability of the health care provider and travel impedance were incorporated in the gravity-based accessibility model (Delamater, Messina, Shortridge, & Grady, 2012; Khan, 1992; Guagliardo, 2004; Penchansky & Thomas, 1981). Based on the generalized gravity model and its applications in measuring spatial accessibility, snowmobile trail network availability and accessibility are important parameters that potentially affect the spatial interaction between Michigan snowmobilers and the snowmobile trail network. Trail mileage and daily snowfall are therefore used to represent the availability of the snowmobile trail network. Distance between

each snowmobiler's residential origin and the destination snowmobiler trail network is defined as the accessibility to snowmobile trail network.

In addition to calibration, the mathematic function of the friction between locations was also estimated and discussed in the literature. Since the spatial interaction between two locations is inversely proportional to the square of the distance between them according to Newton's laws of motion, the friction parameter is usually placed as the denominator with an exponent of two in a gravity model. The gravity model is therefore expressed as:

$$T_{ij} = \frac{A(i)B(j)}{d_{ij}^{\beta}}$$

Researchers generally had few arguments on the calibration of friction between two locations, whether it was defined as distance, travel cost, travel time or other friction means. However, research suggested that the friction exponent (or decay exponent) β varies depending on the geographic area (e.g., urban, suburb, and rural) or human activity (e.g., physical activity versus tourism) (Luo & Wang, 2003; Zhang et al., 2011). A large exponent indicates that the spatial interaction between two locations is sensitive to distance and the likelihood of movement between locations declines quickly. A small exponent generates a smoother travel curve so distance has less effect on spatial interaction (Schuurman, Berube, & Crooks, 2010). Empirical study of the accessibility to recreational facilities provided evidence that the friction exponent differed among types of recreational service provider. Using a linear regression model, Giles-Corti and Donovan (2002) regressed the log of distance on the log of percentage of opportunities to examine the friction exponents for nine different recreational facilities within and around the Perth metropolitan area, Australia. These were: public open space (β =1.91), river (β =1.71), tennis court (β =1.64), beach (β =1.48), gym/health club (β =1.39), swimming pool (β =1.27),

sporting complex (β =1.16), golf course (β =1.06), and other facilities (β =1.03). Results showed that publically accessible facilities or services had larger friction exponents compared to membership or fee-based facilities or services. Although riding on the Michigan snowmobile trail network requires a permit, the yearly cost of $45 is incomparable to that of golf course membership or a gym pass. This research considered the wide distribution of snowmobile trail network a public open space, therefore the friction exponent β =1.91was applied to measure the spatial interaction between Michigan snowmobilers and the snowmobile trail network.

Chapter Three

Research Methods

Research Data

Three sets of data were used to address the research questions: daily snow precipitation for the winter of 2007-08, Michigan snowmobile trail GIS shapefiles, and survey data from the 2008-09 Michigan Snowmobile Use and User Survey.

Snow Precipitation Data

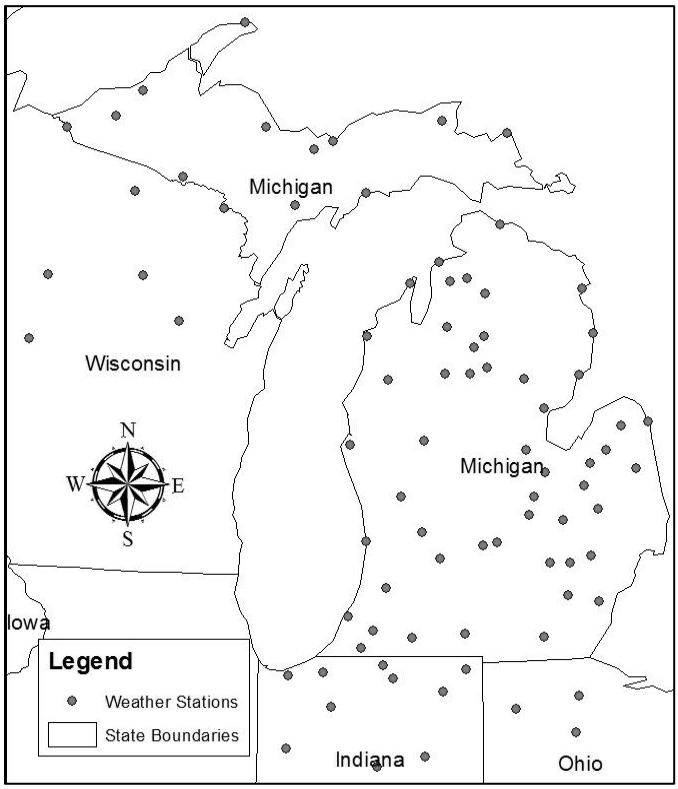

Figure 6 Locations of 82 Weather Stations

Snow precipitation is also known as snowfall. Daily snowfall data for winter 2007-08 from the National Climatic Data Center Summary of the Day Series were purchased from the Office of the Michigan State Climatologist (http://mrcc.isws.illinois.edu/CLIMATE/). The Michigan State Climatologist and the author came to the agreement that daily snowfall data from

October 1st, 2007 to April 30th, 2008 (213 days) best represent the winter days of Michigan. Daily snowfall data were derived from 82 weather stations including three stations in Ohio, five stations in Wisconsin, 10 stations in Indiana, and 64 stations in Michigan. Figure 6 illustrates the location of these weather stations.

Michigan Snowmobile Trail Shapefiles

The Michigan snowmobile trail shapefiles were provided by the Michigan DNR Forest Resources Division. The Michigan DNR constantly seeks to extend the snowmobile trail system, therefore the routes and the total mileage of snowmobile trail may change overtime. Data shapefiles used in this research were received on July 1st, 2013.

Survey Data

Survey research data came from a statewide survey of Michigan snowmobile trail permit purchasers in the winter of 2007-08 (Nelson et al., 2009). The Michigan snowmobile trail permit is required to ride on all public lands (including the designated trail system even if it is on private properties or federal lands) and frozen waters, by both residents and non-residents. There are two ways to obtain the snowmobile trail permit; snowmobilers can purchase the permit from the DNR authorized retail sales system (RSS) by swiping a driver's license at a license terminal or on-line from the DNR, or purchase a permit from vendors (such as the Michigan Snowmobile Association or snowmobile equipment dealers), who are not part of the RSS system, by filling out a paper record. Both permit purchase approaches generate a list of names with their addresses. Since Michigan requires all snowmobiles operated on public lands or trails as well as frozen waters to have a snowmobile trail permit affixed to the forward half of the snowmobile, this research considers the combination of these two lists as the population of legal snowmobilers using public resources in Michigan in the winter of 2007-08.

A total sample of 3,000 names/addresses was selected from the 199,592 Michigan snowmobile trail permit holders in the winter of 2007-08. To create the sample names, 1,905 (63.5%) were randomly selected from the electronic records and 1,095 (36.5%) were systematically selected from the paper records with a random start. This is roughly the proportion of trail permits sold by each means (Stephen Kubisiak, Michigan Department of Natural Resources, pers. comm.).

The sample of 3,000 was evenly divided into three groups for questionnaire mailing, in order to compare snowmobiling travel behaviors during different segments of the snowmobiling season. Questionnaires to the first 1,000 were mailed on January 15th, 2009, the second group was on February 15, 2009, and the third group was on March 15, 2009. Each subject received the questionnaire with a cover letter and a postage paid business reply envelope. The cover letter described the research, how the subject was selected, provided a guarantee of confidentiality, stressed the voluntary nature of participation, and provided contact information for the principal investigator. A reminder postcard was delivered if the survey was not returned in two weeks. After another two weeks, an additional questionnaire, the business reply envelope, and a revised cover letter that encouraged participation were sent to non-respondents. Any survey returned after May 15th, 2009 was not included in the result. Refer to Appendix for the questionnaire, initial cover letter, and second mailing cover letter.

Survey Instrument

The survey instrument was designed in part based on a previous Michigan snowmobile study in 1998 for the purpose of comparison (Nelson, Lynch, & Stynes, 1998). The questionnaire emphasizes snowmobiling behavior and attitudes toward Michigan snowmobile programs and contains 34 questions with 202 variables in six pages.

The behavioral dimension of the instrument includes items relating to household member involvement in snowmobiling in the winters of 2007-2008 and 2008-2009; information about each snowmobile the household owned; previous snowmobile travel behavior to the five different Michigan regions (western Upper Peninsula, eastern Upper Peninsula, northwestern Lower Peninsula, northeaster Lower Peninsula, and southern Lower Peninsula) in both winters; type of trips; information about the most recent Michigan snowmobiling trip; economic involvement in the previous 12 months; and experience of encountering a law enforcement officer.

Attitudinal dimension items includes overall satisfaction and level of satisfaction toward nine selective services provided by the Michigan snowmobile program; perception of crowding; improvement suggestions; support of pertinent policies, willingness to pay for snowmobiling opportunities; and, perceptions of risk for nine selected snowmobiling behaviors.

In addition to behavioral and attitudinal questions, the survey asked general questions about each snowmobiler's lifestyle. These questions included participation in 16 other outdoor activities; five digit home zip code; current age and age began snowmobiling; and snowmobiling organization membership.

To address this study's research questions, only a portion of the survey results were used for further statistical analysis. The total number of snowmobile machines owned by the household; economic involvement in the previous 12 months; current age and age began snowmobiling; total miles driven; total days spent snowmobiling; and snowmobiling organization membership were used to assess respondents' recreational specialization. Perceptions of risk for nine selected snowmobiling behaviors were used to assess respondents' perceptions of snowmobiling risks. Total days spent snowmobiling and snowmobile days in five different Michigan regions were used to

assess respondents' spatial interaction with the snowmobile trail network. The full survey can be found in the Appendix.

Data Analysis

There were 1,128 snowmobilers who completed and returned the survey. Based on their reported residential zip codes, 853 (76%) were Michigan residents and 275 (24%) were non-residents. Due to differential state snowmobile registration fees in other states, this study only uses Michigan respondents, as all of them paid the same Michigan snowmobile registration fee as well as the same Michigan trail permit fee.

Although the survey asked snowmobilers to report their riding experience in the winters of both 2007-08 and 2008-09, data for winter 2008-09 was not complete for most respondents as they responded before the 2008-09 snowmobiling season was completed. Hence, this research used only the snowmobiling experience data of winter 2007-08 for further analysis.

Measuring Recreational Specialization

Recreational specialization serves as the independent variable of this research. The three-dimensional measurement of behavior, skill/knowledge, and psychological attachment, proposed by Scott and Shafer (2001) was followed to measure snowmobilers' recreational specialization. Table 1 summarizes the scale and data type of the three specialization dimensions.

Table 1 Dimension, Data Type, and Scale of Snowmobile Specialization Measurement

Variable Name	Data Type	Scale
Behavior		
Numbers of snowmobiles owned	Ratio	Number
Money spent on snowmobiling in the last 12 months ($)	Ratio	Number
Snowmobiling experience (Current Age – Begin Age) / Current Age	Ratio	Percentage
Skill/Knowledge		
Total snowmobile days in winter 07-08	Ratio	Number
Total miles driven in winter 07-08	Ratio	Number
Psychological Attachment		
Snowmobile organization membership	Ratio	Number

The behavioral dimension includes three variables: numbers of snowmobiles owned, money spent on snowmobiling in the previous 12 months, and snowmobiling experience. Amount of equipment owned has proven to be effective in measuring the level of specialization (Bryan, 1977; Dyck, et al., 2003). The more snowmobiles owned indicates a higher level of specialization. Further, financial investment in equipment purchase and operation represents intensity of participation. Although expenditure may be due to conspicuous consumption (Scott & Shafer, 2001), financial investment has proven to be a valid measure of recreational specialization (Cole & Scott, 1999; Wöran & Arnberger, 2012). Finally, snowmobile experience was measured using the proportion of one's life he/she has snowmobiled. Survey respondents were asked their current age and the age they began snowmobiling; to avoid age bias, snowmobiling experience was stated as a percentage and calculated as:

(Current Age – Age Begin Snowmobiling) / Current Age = Snowmobiling Experience

This method has been used to assess specialization among skiers and snowboarders (Needham & Little, 2013), OHV riders (Smith et al., 2010), and deer hunters (Needham et al., 2007).

The skill/knowledge dimension was measured through snowmobilers' recent experience and consisted of two variables: total snowmobile days in winter 2007-08 and total miles driven

in the winter of 2007-08. Past experience has been a reliable indicator of specialization (Dyck, et al., 2003; McFarlane, 1996; Virden and Schreyer, 1988). Lynch (2000) found that convicted snowmobile law violators rode significantly more days and more miles than other snowmobilers. Prevailing recreational specialization studies used self-reported skill level (Oh, Ditton, Anderson, Scott, & Stoll, 2005; Thapa et al., 2006) and knowledge of the activity (i.e., number of bird species observed over the lifetime for birders; Lee & Scott, 2006; Won, Bang, & Shonk, 2008) to measure this dimension. Since the survey did not ask respondents to rate their skill level, this research considered the riding skills cumulated in the past snowmobile season a valid measurement for skill level. The proficiency of riding snowmobiles is hypothesized to increase along with riding days and miles. Riding a snowmobile more frequently indicates a higher skill level.

Snowmobiling organization membership was used to measure the psychological attachment dimension of snowmobiling specialization. Two questions were asked in the survey: a dichotomous "Are you a member of a snowmobiling association or club" and an open-ended question "Please list each organization." The responses to both questions were recoded into a new variable "snowmobiling organization membership." Respondents who reported "No" in the former question were coded "0" in the new variable. For those who reported "Yes," the researcher counted the number of organizations or clubs listed in the open-ended question and used the resulting number for the new variable. If respondents reported "Yes" for the first question but did not list any organization in the second question, a "1" was assigned to the variable. Membership has been an essential indicator of the psychological attachment dimension of recreational specialization (Kuentzel & McDonald, 1992; Oh et al., 2005; Smith et al., 2010),

while more snowmobile club or association memberships indicates an even higher level of snowmobile specialization.

Identifying Snowmobile Specialization

Both a summative index and cluster analysis were applied to segment snowmobilers' levels of recreational specialization. The results of these two approaches were compared to decide which method was more meaningful and appropriate for investigating the social world of Michigan snowmobilers. Because the recreational specialization variables were in different measurement ranges and units, each variable was standardized to a mean of zero and a standard deviation of one in preparation for the analyses that followed. The descriptive statistics, percentages of the identified subgroups, and between-group differences were used as criteria to justify which method and subgroups to be applied for examining the research hypotheses.

For the summative index method, this research adopted procedures executed in previous recreational specialization research (e.g., Dyck, et al., 2003; Smith et al., 2010). All six standardized scores were summed for each survey respondent to represent his/her specialization index score. The index score for all research samples formed a continuum of snowmobile recreational specialization. These samples were then evenly divided into three specialization subgroups (Expert, Intermediate, and Novice) based on their location on the specialization continuum. The least specialized 33.3% of the sample was defined as novice snowmobilers, the middle 33.3 % of the sample was defined as intermediate snowmobilers, and the highest 33.4 % of the sample was defined as expert snowmobilers. Once the specialization subgroups were identified, they were compared using the original (non-standardized) six indicators of behavior, skill/knowledge, and psychological attachment. Descriptive statistics were used to understand distinct characteristics of the three levels of snowmobile specialization. A between-group

analysis of variance (ANOVA) was performed to test the behavior, skill/knowledge, and psychological attachment characteristic differences between levels of snowmobile specialization (Hypothesis 1) using IBM SPSS Statistics computer program.

For cluster analysis, a non-hierarchical K-mean cluster analysis was used to determine specialization clusters with homogeneous behavioral, skill/knowledge, and psychological attachment characteristics. Hair and his colleagues (1998) suggested that K-mean cluster analysis is the most efficient approach to segment clusters. K-mean cluster analysis has also proven effective in generating meaningful subgroups in the recreational specialization literature (McFarlane, 1994; Needham et al., 2007; Scott et al., 2005). To enable comparison with the summative approach, this study chose three clusters. Three cases were therefore randomly selected as the initial, temporary cluster centers, and then updated in an interactive process to minimize the within-cluster sum of squares (Hartigan & Wong, 1979). The maximum number of iterations for updating of cluster centers was set to 20. The F test within ANOVA was performed to test cluster validity and the characteristic differences between clusters of snowmobiling specialization. Once the three clusters were identified, they were compared using the original (non-standardized) six indicators of behavior, skill/knowledge, and psychological attachment. Descriptive statistics were used to understand distinct characteristics between the three clusters and address hypothesis one.

Measuring Perception of Risk

This research defines the perception of risk as the attitudinal interpretation a snowmobiler holds when confronted with a potential hazardous situation or stimulus while snowmobiling. A list of snowmobiling scenarios that was used by Lynch (2000) for assessing snowmobilers' perception of risky behavior was adopted for this research. The nine item list includes: operation

of snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol); operation of snowmobile by a legally intoxicated person (0.08 or higher blood alcohol); speed of snowmobile; driver lacking skill in operating machine; cars/trucks on seasonal roads; public trail conditions; public trail design; other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing); and snowmobiling on county/state road shoulders. A five-point rating scale was used to measure snowmobilers' attitudinal interpretation, ranging from one (not dangerous) to five (extremely dangerous). Higher scores indicate higher perception of risk and danger. Since the respondents saw both rating numbers (from one to five) and descriptions (from not dangerous to extremely dangerous) while reporting their perceptions of risk on the survey, this research treated the rating scale as interval data, meaning the difference between rating one and two was the same as the difference between rating four and five. Cronbach's alpha was computed as an internal consistency estimate of reliability (Vaske, 2008). Table 2 displays the scale and data type of measures of perceptions of risk.

Table 2 Scale and Data Type of the Perception of risks Measurement

Variable Name	Data Type	Scale
Operation of snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol)	Interval	1) Not Dangerous 2) Slightly Dangerous 3) Moderately Dangerous
Operation of snowmobile by a legally intoxicated person (0.08 or higher blood alcohol)	Interval	4) Highly Dangerous 5) Extremely Dangerous
Speed of snowmobile	Interval	
Driver lacking skill in operating machine	Interval	
Cars/trucks on seasonal roads	Interval	
Public trail conditions	Interval	
Public trail design	Interval	
Other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing)	Interval	
Snowmobiling on county/state road shoulders	Interval	

The relationship between levels of snowmobiling specialization and nine perceptions of risks was tested with an effect size index Eta (η). Eta measures the association of a continuous level dependent variable and a categorical independent variable. An Eta value between .10 and .242 represents a weak relationship between two variables, a value between .243 and 370 represents a moderate relationship, and a value of .371 or greater represents a strong relationship (Vaske, 2008). In addition, Eta squared (η^2) was assessed to interpret the amount of variance in the dependent variable that was explained by the independent variable. Correlations between each of nine selected perception of risks and recreational specialization were used to address hypotheses two to ten.

In addition to the effect size index Eta, the analysis of variance was applied to address the perception of risk difference across three specialization sub-groups. The multivariate analysis of variance (MANOVA) was applied to address the overall sub-group difference on nine perception of risk. Instead of performing a one-way ANOVA nine times, MANOVA is known for examining the main and interaction effects of several correlated dependent variables (Vaske, 2008). MANOVA is sensitive not only to mean differences but also to the direction and size of correlations among the dependent variables. Therefore, MANOVA increases the chance of finding a group difference compared to ANOVA. A multivariate F value (Wilks' Λ) was obtained to test the significance of group difference. Similar to ANOVA, a Post Hoc Tukey's Honesty Significant Difference test was performed for testing individual differences between specific subgroups (i.e., Expert and Novice, Novice and Intermediate, and Intermediate and Expert).

Measuring Spatial Interaction

Since the literature related to snowmobiling or recreational specialization lacked studies focused on spatial interaction, this research borrowed the measuring concept from the health geography literature (Delamater et al., 2012; Khan, 1992; Zhang et al., 2011). According to the generalized gravity model,

$$T_{ij} = \frac{A(i)B(j)}{d_{ij}^{\beta}}$$

, the calibration of the spatial interaction between Michigan snowmobilers and the trail network should include origin and destination attributes, and the friction parameter. Because this research aimed at assessing each snowmobiler's spatial interaction with the Michigan snowmobile trail network, the origin attribute for each snowmobiler was set at 1.

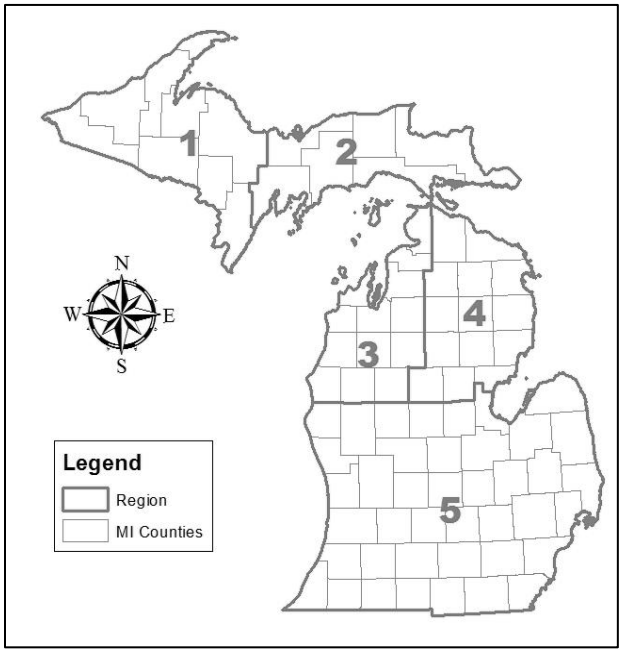

Figure 7 Michigan's Five Regions

To meet resource management and marketing strategy development needs, the survey divided Michigan into five regions (See Figure 7 for Five Regions). Each survey respondent was

asked to report their days spent snowmobiling in each region. The spatial interaction between snowmobilers and the snowmobile trail network therefore was measured based on these managerial regions.

The destination attribute is defined as the availability of the snowmobile trail network. Availability refers to the volume and type of existing services (Penchansky & Thomas, 1981). Therefore, total snowmobile trail mileage and snow precipitation in winter 2007-08 in each region were defined as the availability of Michigan snowmobiling opportunity.

The friction parameter, or accessibility, on the other hand, referred to the travel cost between residential origin and destination (Widener, Farber, Neutens, & Horner, 2013). Travel cost can be calculated using Euclidean distance, actual travel distance, travel time, or cognitive distance. This research used Euclidean distance to measure accessibility to Michigan's snowmobile trail network for the following reasons. First, the road network in Michigan is well constructed in both north-south and east-west directions. Using Euclidean distance measurement can represent the magnitude and variation of travel distance in such a large scale as statewide travel. Second, Michigan is divided into Upper and Lower Peninsulas by the Mackinac Bridge. This research measured Euclidean distance using the middle point of the Bridge as the starting or ending point if cross-peninsula travel was calculated. This approach aided in measurement accuracy by avoiding non-existent travel paths crossing over the Great Lakes. Lastly, Euclidean distance measurement is less time consuming because of fewer computational inputs compared to road network analysis and is likely to yield a more generalizable result. While incorporating real-world traffic network may provide a more accurate measurement of travel distance or travel cost than Euclidean distance measurement, the survey didn't ask if respondents took the shortest distance between their origin and their snowmobiling destination; using the shortest road

network distance may therefore not be a fully accurate representation of snowmobilers' travel behavior.

To calculate the distance between origin and each region, a destination point needed to be located in order to best represent the trail network a snowmobiler visited in the winter 2007-08. The most snowmobile friendly point in each region, defined as the centroid point of the county in each region with the largest product of average snowfall and trail mileage, was located in order to calculate distance between origin and destination regions.

While availability and accessibility of snowmobiling opportunity provide objective measurements of spatial interaction between Michigan snowmobilers and the trail network, actual participation is the realization of subjective input. The percentage of actual participation reflects the preference each snowmobiler has for different destinations. Therefore, total snowmobile days and snowmobile days in each Michigan managerial region in the winter of 2007-08 were incorporated into the measure of spatial interaction.

In sum, the measure of the spatial interaction between Michigan snowmobilers and the snowmobile trail network included each snowmobiler's snowmobile days within the region, Euclidean distance to each region's most snowmobile friendly point, snowmobile trail mileage within the region, and winter snow precipitation within the region. The gravity model was adapted to account for the availability and accessibility of Michigan snowmobiling opportunity, while the percentage of actual participation spent in each region was applied to weight the spatial interaction.

Each respondent's spatial interaction with the Michigan snowmobile trail network in each region was therefore be calculated by:

$$T_{ij} = \frac{a_j}{D} \times \frac{b_j c_j}{d_{ij}^{\beta}}$$

Where T_{ij}: Spatial interaction between origin i and region j

a_j : Snowmobile days in region j

b_j : Trail mileage in region j

c_j : Winter snowfall in region j

d_{ij}: Distance from residential origin i to region j

D : $\sum_{i=1}^{5} a_i$ (Total snowmobile days in Michigan)

Snowmobile days in region j (a_j) were derived from the survey data. Respondents were asked to report their snowmobile days in winter 2007-08 in each of the five regions. Snowmobile days in five regions were totaled to compute D (Total snowmobile days in Michigan). Trail mileage in region j (b_j) was calculated using the Michigan Snowmobile Trail shapefile and the overlay function "identity" in ESRI's ArcGIS 10.1. Winter snowfall in region j (c_j) was calculated by using snow precipitation data and ESRI's ArcGIS 10.1, described in detail in the next section.

In the gravity model, the distance (d_{ij}) is placed as the denominator to account for distance decay. The distance decay parameter β was set to 1.91 for the spatial accessibility measures when using public open spaces (Giles-Corti & Donovan, 2002). The distance (d_{ij}) was measured from each respondent's residential origin to the most snowmobile friendly point of each destination region. The mailing address of each survey respondent served as the residential origin. For those who use a Post Office Box (P.O. Box) as their mailing address, the centroid of their reported zip-code was used as the residential origin to calculate distance. Addresses of

survey respondents were geocoded into coordinates with latitude and longitude data using an on-line geocoding source (http://www.findlatitudeandlongitude.com/). As mentioned earlier, the middle point of the Mackinac Bridge was used as the starting and ending point if cross-peninsula travel was calculated. Distance between the residential origin and the destination point in each region was measured by using a proximity function "Point Distance" in ESRI's ArcGIS 10.1.

Calculating Winter Snowfall in Region j

Winter snowfall in each region was derived from a continuous raster surface representing Michigan snow precipitation, which was created by a spatial interpolation method called kriging. All procedures utilized snow precipitation data in ESRI's ArcGIS 10.1. Daily snow precipitation for winter 2007-08 (213 days) was summed to create the Z value for each weather station for the procedures that followed. The X and Y coordinates for all 82 weather stations and their Z values (accumulated snowfall) were plotted as the input point feature for kriging. The ordinary kriging method was used, with an exponential semivariogram model, 12 neighbor points, and the raster resolution of one inch by one inch grid, to visualize the continuity and variability of the snowfall across Michigan. Once the snowfall surface was created, the five region shapefile was used as the mask layer and a zonal function "zonal statistics as table" was used to calculate the winter snowfall for each region and present the results in a table.

Assessing the Relationships between Spatial Interaction and Specialization

Spatial interaction for each survey respondent was treated as continuous data. Therefore, the relationship between spatial interaction with Michigan's snowmobile trail network and snowmobile specialization was tested with an effect size index Eta (η). The value of η was used to indicate the strength and the direction of the relationship (Vaske, 2008). Correlation between spatial interaction and recreational specialization was utilized to examine hypothesis 11.

Additionally, the one-way ANOVA was run to test how different specialization subgroup affected snowmobilers' spatial interaction with the snowmobile trail network. The post-hoc comparison used Tukey's Honesty Significant Difference test to examine spatial interaction differences among snowmobile specialization groups. A significance level of .05 was used to determine whether to reject the null hypothesis. Setting the level of significance at .05 reduces the probability of committing a Type II error while slightly increasing the probability of committing a Type I error.

Definition and Treatment of Outliers

Extreme values may substantially distort the results of survey data, making analysis problematic. To address research question one and to ensure the generic characteristics of Michigan snowmobilers were well represented, outliers were identified and treated as a special group. This identified group was excluded from the process of identifying recreational specialization subgroups and was termed extreme cases hereafter.

A standardized Z-score was calculated for each of the six recreational specialization variables to identify outliers. Traditionally, any value beyond three standard deviations of the mean was suggested as an outlier (Stevens, 2009). To preserve the variability of the data, this research used six standard deviations to help identify outliers. Those cases with any recreational specialization variable Z value six or larger (≥ 6) or minus six or smaller (≤ -6) were set aside as extreme cases.

Treatment of Missing Data

Missing data existed in both the survey and snow precipitation data. To reduce bias in the analysis and findings when missing data occurred, two approaches were used: the delete respondent solution and the sample means solution (Vaske, 2008).

For survey data, the delete respondent solution was first used to deal with missing values. The entire case was omitted from the sample when any of these four criteria applied: no residential address was available; snowmobile days in five regions was missing; three or more (out of six) recreational specialization variables were missing; and four or more (out of nine) perception of risk variables were missing. After omitting outliers, the sample mean of the variable was then applied to replace missing values for the rest of the cases. Although using sample means solution reduces variability, the solution provides conservative correlation coefficients when comparing to replacing missing data with group means or random assignments within groups.

For the snow precipitation data, there were missing values randomly distributed across the dataset. To make sure all weather stations provided precipitation data for the entire winter of 2007-08 for spatial analysis, the missing values of each weather station were replaced by the station mean precipitation.

Chapter Four

Research Findings

This chapter presents the research findings and addresses the research questions and hypotheses. There are two sections in this chapter: descriptive statistics and inferential statistics.

Descriptive Statistics

This section provides descriptive results derived from Michigan snowmobiler survey data, Michigan snow precipitation data, and Michigan snowmobile trail network GIS shapefile data. Major components include general descriptive statistics of the research data with a focus on the three themes of this research: recreational specialization, perception of risk, and spatial interaction.

Surveyed Michigan Snowmobilers

Of those 853 Michigan residents who completed and returned the survey, 39 cases were omitted from the analysis because no residential address was available, data on snowmobile days in the five regions were missing, three or more (out of six) recreational specialization variables were missing, or four or more (out of nine) perception of risk variables were missing. An additional seven cases were defined as extreme cases and were excluded from the process of identifying recreational specialization subgroups. A total of 807 cases with the necessary data for analysis were retained. Among them, 573 (71.0%) lived in region five (southern Lower Peninsula), 91 (11.3%) lived in region four (northeastern Lower Peninsula), 82 (10.2%) lived in region three (northwestern Lower Peninsula), 31 (3.8%) lived in region one (western Upper Peninsula), and 30 (3.7%) lived in region two (eastern Upper Peninsula). All valid addresses were aggregated to the county level and plotted in Figure 8.

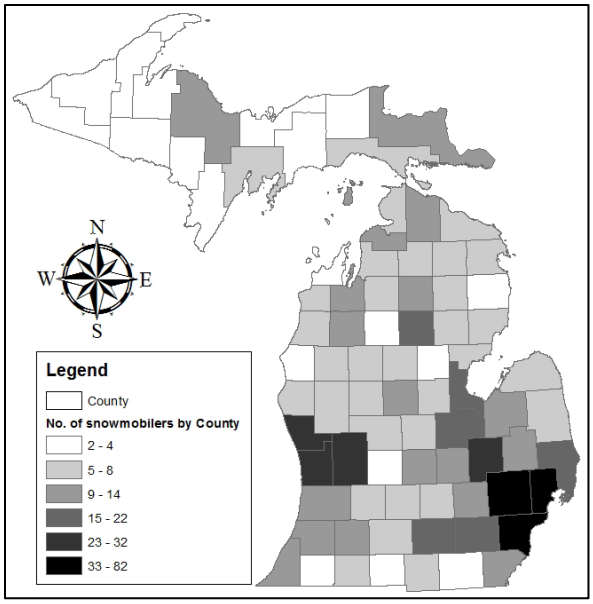

Figure 8 Number of Surveyed Snowmobilers by County

The Year of 2007-08 Winter Snowfall

The continuous raster surface representing Michigan snow precipitation was created by ordinary kriging. The zonal function "zonal statistics as table" was used to calculate the winter snowfall for each region. On average, region two (eastern Upper Peninsula) had the highest winter snowfall of 138.4 inches, followed by 136.9 inches in region one (western Upper Peninsula), 102.6 inches in region three (northwestern Lower Peninsula), 83.7 inches in region four (northeastern Lower Peninsula), and 74.2 inches in region five (southern Lower Peninsula). Table 3 shows the descriptive statistics of winter snowfall while figure 9 demonstrates the continuous surface of winter 2007-08 snowfall and the allocation of the Michigan snowmobile trail network.

Table 3 Winter Snowfall by Region (2007-08)

Region	Mean	S.D.
Region 2	138.4	32.1
Region 1	136.9	34.4
Region 3	102.6	12.7
Region 4	83.7	16.8
Region 5	74.2	19.0

S.D = Standard Deviation

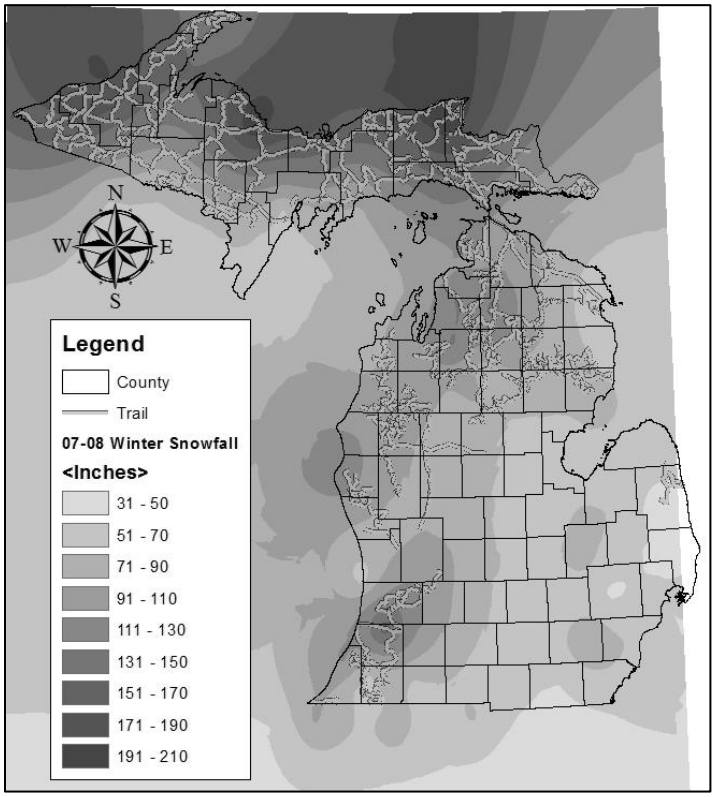

Figure 9 Winter 2007-08 Snowfall Kriging Surface with Snowmobile Trail

Michigan Snowmobile Trail

The overlay function "identity" was used to calculate trail mileage for each region. The result showed that region one (western Upper Peninsula) had the most snowmobile trail mileage, followed by region two (eastern Upper Peninsula), region four (northwestern Lower Peninsula, region three (northeastern Lower Peninsula), and region five (south Lower Peninsula). Region one had 1,819 miles of snowmobile trail, region two had 1370.5 miles, region four had 1194.6 miles, region three had 994.6 miles, and region five had 809.4 miles. Figure 10 illustrates the distribution of the snowmobile trail network in the five regions of Michigan.

Figure 10 Snowmobile Trail Network in Five Regions

Most Snowmobile Friendly Point in Each Region

As the research divided Michigan into five managerial regions, the most snowmobile friendly point in each region was defined as the centroid point of the county with the greatest product of average snowfall and trail mileage. The centroid point of Ontonagon County was identified as the most snowmobile friendly point for region one (western Upper Peninsula), Chippewa County for region two (eastern Upper Peninsula), Lake County for region three (northwestern Lower Peninsula), Oscoda County for region four (northeastern Lower Peninsula), and Cass County for region five (southern Lower Peninsula). These most snowmobiler friendly points were utilized to calculate the distance between each snowmobiler's residential origin and their snowmobile destination in each region. Figure 11 illustrates the location of the most snowmobile friendly point for all five regions.

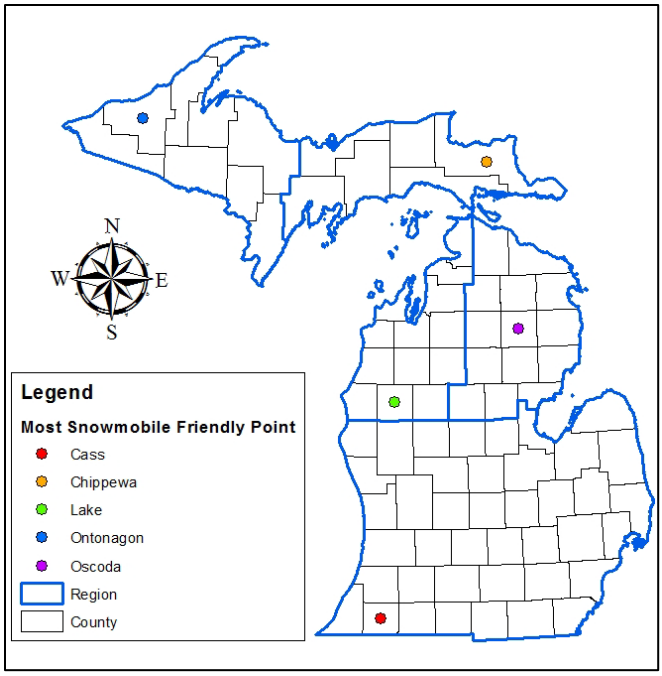

Figure 11 Most Snowmobile Friendly Point in each Region

General Characteristics of Michigan Snowmobilers

Six variables were selected to assess Michigan snowmobilers' recreational specialization. On average, Michigan snowmobilers owned two snowmobiles, spent 1,954 dollars on snowmobile related items such as maintenance and insurance in the previous 12 months, had snowmobiled for 58% of their life, and rode their snowmobiles 21 days traveling 1,544 miles in the winter of 2007-08. Only 25% of them belonged to one or more snowmobile associations or clubs. Table 4 presents the descriptive statistics of Michigan snowmobilers' general characteristics.

Table 4 Michigan Snowmobilers' General Characteristics

Variable	Mean	Minimum	Maximum	S.D.
Numbers of snowmobiles owned	2.4	1	5	1.1
Money spent in the last 12 months ($)	1953.6	0	23900	3424.6
Snowmobiling experience	.58	.02	.98	.23
Snowmobile days in winter 07-08	20.9	0	128	18.3
Miles driven in winter 07-08	1544.0	0	8250	1345.5
Snowmobile membership	.3	0	3	.5

S.D = Standard Deviation

Michigan Snowmobilers' General Perception of Risk and Internal Consistency

Nine snowmobile riding hazards were utilized to assess Michigan snowmobilers' perception of risk. A five point Likert Scale, ranging from one being not dangerous to five being extremely dangerous, was provided for describing snowmobilers' perception of risk. The result showed that Michigan snowmobilers considered "Operation of snowmobile by a legally intoxicated person" (4.4), "Driver lacking skill in operating machine" (4.1), and "Speed of snowmobile" (3.8) highly dangerous; "Operation of snowmobile by person who has been drinking but is not legally intoxicated" (3.3), "Cars/trucks on seasonal roads" (3.1), and "Other uses of designated snowmobile trails" (2.8) moderately dangerous; and "Public trail conditions" (2.4), "Snowmobiling on county/state road shoulders" (2.2), and "Public trail design" (2.1) slightly dangerous.

Table 5 Descriptive Statistics and Reliability of Snowmobiling Perception of Risk

Variable Name	Mean*	S.D.
Operation of snowmobile by a legally intoxicated person (0.08 or higher blood alcohol)	4.4	0.9
Driver lacking skill in operating machine	4.1	1.0
Speed of snowmobile	3.8	1.1
Operation of snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol)	3.3	1.4
Cars/trucks on seasonal roads	3.1	1.2
Other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing)	2.8	1.3
Public trail conditions	2.4	1.1
Snowmobiling on county/state road shoulders	2.2	1.0
Public trail design	2.1	1.0

** Based on a five point Likert scale with 1being Not Dangerous, 2 Slightly Dangerous, 3 Moderately Dangerous, 4 Highly Dangerous, and 5 Extremely Dangerous*
Internal consistency score: *Cronbach's $\alpha = 0.76$*

Overall, the reliability analysis demonstrated that the nine items in the Michigan snowmobiler perception of risk measurement had a fairly adequate level of internal consistency

(Cronbach's $\alpha = 0.76$). Table 5 shows the descriptive statistics for the nine items of Michigan snowmobiling perception of risk.

Michigan Snowmobilers' Actual Participation

The results were grouped based on respondents' residential region as snowmobilers from the same region were more likely to face similar situations with regard to the spatial distribution and structure of the snowmobile trail network. The survey asked snowmobilers to report their snowmobiling days in each of the five Michigan regions. The results showed that survey respondents who did not live in region five (southern Lower Peninsula) were more likely to snowmobile in their own residential region, while the majority of the respondents (71%) who lived in region five tended to snowmobile in regions three and four. On average, respondents who lived in region one (western Upper Peninsula) spent 20 days in the winter of 2007-08 snowmobiling in the western Upper Peninsula and about 3 days in region two (eastern Upper Peninsula). Respondents who lived in region two spent 19 days snowmobiling in their residential region and about 2 days in the western Upper Peninsula. According to the results, those who lived in the Upper Peninsula did not go to the lower half of Michigan for snowmobiling.

On the other hand, for those who lived in the northern half of the Lower Peninsula, region two, three (Northwestern Lower Peninsula), and four (Northeastern Lower Peninsula) were their preferred snowmobile destinations. Survey respondents who lived in region three spent 21 days in their own region, 3 days in region two, and about a day in region one and region four. They seldom went to region five for snowmobiling. Those who lived in region four spent 20 days snowmobiling in their own residential region, 6 days in region three, 2 days in region two, and less than a day in region one. No snowmobilers from region four went to region five for snowmobiling. The majority of the survey respondents lived in region five but tended to spend

their winter snowmobiling in the northern half of the Lower Peninsula of Michigan. On average, they spent 7 days in region three, 4 days in region four, 4 days in region five, 3 days in region two and 1 day in region one.

Table 6 Michigan Snowmobilers' Actual Participation in Five Michigan Regions

Residential Region	N	Destination Region	Mean	S.D.
Region 1 (western Upper Peninsula)	31 (4%)	Region 1	20.1	17.6
		Region 2	2.6	7.7
		Region 3	.0	.0
		Region 4	.0	.0
		Region 5	.0	.0
Region 2 (eastern Upper Peninsula)	30 (4%)	Region 1	1.9	5.0
		Region 2	19.4	21.3
		Region 3	.0	.0
		Region 4	.0	.0
		Region 5	.0	.0
Region 3 (northwestern Lower Peninsula)	82 (10%)	Region 1	.8	2.4
		Region 2	2.7	7.6
		Region 3	20.7	21.6
		Region 4	.5	2.4
		Region 5	> .0	.2
Region 4 (northeastern Lower Peninsula)	91 (11%)	Region 1	.4	2.2
		Region 2	2.1	4.9
		Region 3	6.0	12.6
		Region 4	20.0	22.6
		Region 5	.0	.0
Region 5 (southern Lower Peninsula)	573 (71%)	Region 1	1.0	2.9
		Region 2	2.9	5.8
		Region 3	6.9	11.3
		Region 4	4.1	7.3
		Region 5	4.0	8.3
Overall	807 (100%)	Region 1	1.7	5.8
		Region 2	3.4	7.8
		Region 3	7.7	13.4
		Region 4	5.2	11.2
		Region 5	2.9	7.3

Overall, the northern half of the Lower Peninsula was the most common destination for all Michigan snowmobilers as they spent 8 days snowmobiling in region three and 5 days in region four. Region two was the preferred destination in the Upper Peninsula with 3 snowmobiling days. Additionally, Michigan snowmobilers spent a little less than 3 days in

region 5 and about 2 days in region one. Table 6 presents the descriptive statistics for Michigan snowmobilers' actual participation overall and in each region.

Travel Distance to Michigan Snowmobile Trail Network

Spatial accessibility of Michigan snowmobile trail network was measured by Euclidean distance from all respondents' mailing addresses to the most snowmobile friendly point in each region, regardless if the respondent actually traveled to the region for snowmobiling or not. The longest mean distance Michiganders traveled to snowmobile was 393 miles to region one (western Upper Peninsula), followed by 214 miles to region two (eastern Upper Peninsula), 159 miles to region five (southern Lower Peninsula), 129 miles to region four (northeastern Lower Peninsula), and 125 miles to region three (northwestern Lower Peninsula). Table 7 presents the descriptive statistics of travel distance to snowmobile trail network in each region.

Table 7 Average Travel Distance for All Snowmobilers to Trail Network in each Region

Destination Region	Mean	S.D.
Distance to Region 1	392.5	101.2
Distance to Region 2	214.2	69.8
Distance to Region 5	158.9	88.5
Distance to Region 4	128.7	55.1
Distance to Region 3	124.8	61.4

Spatial Interaction between Snowmobiler' Residential Region and Snowmobile Trail Network

Spatial interaction between Michigan snowmobilers' residential region and the snowmobile trail network was defined as the function of snowmobile trail network availability, accessibility, and snowmobilers' actual participation in each region. Because the distribution of all spatial interaction was highly skewed (skewness range from 15.3 to 28.7; kurtosis range from 267.7 to 823.4), this research ranked spatial interaction. It ranked all 807 respondents with rank 1 meaning the least spatial interaction and rank 807 meaning the most spatial interaction. A mean rank was reported instead of mean score. The descriptive spatial interaction results showed that

region three (northwestern Lower Peninsula) received the most spatial interaction among five Michigan regions with a mean rank of 333.6. This is followed by region four (northeastern Lower Peninsula) with a mean rank of 263, region two (eastern Upper Peninsula) with 258, region five (southern Lower Peninsula) with 184.3, and region one (western Upper Peninsula) with 146.2. Table 8 shows the descriptive statistics of spatial interaction between all Michigan snowmobilers' residential region and the snowmobile trail network in each region.

Table 8 Total Spatial Interaction Received by Snowmobile Trail Network Destination Region

Destination Region	Mean Rank	Sum	S.D.
Region 3	333.6	25049.9	309.5
Region 4	263.0	65747.2	1843.0
Region 2	258.0	32191.1	757.1
Region 5	184.3	6711.7	2017.6
Region 1	146.2	9329.2	146.2

Due to proximity, Michigan snowmobilers had the most spatial interaction within their own residential region. For regions other than their residential region, snowmobilers who lived in region one had the most spatial interaction with the eastern Upper Peninsula; snowmobilers in region two had the most spatial interaction with the western Upper Peninsula; snowmobilers in region three tended to have more spatial interaction with the eastern Upper Peninsula than other regions; snowmobilers in region four had the most spatial interaction with the northwestern Lower Peninsula; and, those who lived in region five also had the most spatial interaction with the northwestern Lower Peninsula. Additionally, snowmobilers from the Upper Peninsula (region one and two) had zero spatial interaction with the Lower Peninsula (region three, four, and five). Those who lived in the northern Lower Peninsula had minimal spatial interaction with the southern Lower Peninsula.

Table 9 Spatial Interaction between Snowmobilers and Trail Network by Region

Residential Region	Destination Region	Sum	Mean Rank	S.D.
Region 1	Region 1	9175.1	812.4	697.9
(western Upper Peninsula)	Region 2	29.3	173.8	2.2
	Region 3	.0	1.0	.0
	Region 4	.0	1.0	.0
	Region 5	.0	1.0	.0
Region 2	Region 2	31151.5	780.8	3854.8
(eastern Upper Peninsula)	Region 1	66.0	211.4	5.8
	Region 3	.0	1.0	.0
	Region 4	.0	1.0	.0
	Region 5	.0	1.0	.0
Region 3	Region 3	20057.0	675.5	948.5
(northwestern Lower Peninsula)	Region 2	319.0	210.2	9.5
	Region 4	103.9	73.9	2.0
	Region 1	15.8	102.1	.7
	Region 5	.2	8.7	> .0
Region 4	Region 4	64252.1	648.0	5474.8
(northeastern Lower Peninsula)	Region 3	633.0	244.4	13.0
	Region 2	191.1	206.7	5.2
	Region 1	3.3	41.2	.2
	Region 5	.0	1.0	.0
Region 5	Region 5	6711.5	258.0	72.6
(southern Lower Peninsula)	Region 3	4359.9	334.2***	17.6
	Region 4	391.2	256.8**	4.8
	Region 2	500.2	250.2*	1.5
	Region 1	69.0	129.7	.3

*** *Highest spatial interaction*
** *Second highest spatial interaction*
* *Third highest spatial interaction.*

For cross-regional travel, as table 9 shows, the highest spatial interaction occurred when snowmobilers from region five traveled to the northwestern Lower Peninsula for snowmobiling, and the second highest spatial interaction happened when snowmobilers from region five traveled to the northeastern Lower Peninsula for snowmobiling. When snowmobilers from region five traveled to the eastern Upper Peninsula for snowmobiling, they generated the third highest spatial interaction during the winter of 2007-08.

Inferential Statistics

This section presents the results of the inferential statistics which were used to address the research questions and hypotheses. The section first addresses results of using summative indices and cluster analysis for identifying Michigan snowmobilers' recreational specialization. Secondly it focuses on the influence of specialization on the perception of snowmobiling risks and spatial interaction.

Michigan Snowmobilers' Recreational Specialization

The theoretical framework of recreational specialization was utilized to study the within-group social world of Michigan snowmobilers. Using a summative index and cluster analysis are two common classification approaches for identifying different levels of recreational specialization. The statistical results of both approaches were used to address research question one: What are the behavior, skill/knowledge, and psychological attachment characteristics of snowmobilers in different levels of specialization using summative indices and cluster analysis?

Summative Index for Recreational Specialization

After the specialization continuum was formed, three subgroups: expert, intermediate, and novice, with 269 Michigan snowmobilers in each, were identified. Overall, novice snowmobilers owned little less than 2 snowmobiles, spent 539 dollars on snowmobile related items such as maintenance and insurance in the previous 12 months, had snowmobiled for 45% of their life, and rode 11 days traveling 648 miles in the winter of 2007-08. Only 6% of them belonged to a snowmobile association or club.

Intermediate snowmobilers on average owned slightly more than 2 snowmobiles, spent 1,130 dollars for snowmobiling related items, had snowmobiled for 62% of their life, and rode

18 days traveling 1,277 miles in the winter of 2007-08. About 24% of them participated in snowmobile associations or clubs.

The expert snowmobilers generally owned 3 sleds, spent 4,192 dollars on snowmobiling maintenance, insurance, and other related items, had snowmobiled for 69% of their life, and rode 33 days traveling 2,707 miles in the winter of 2007-08. About 46% of them were a member of snowmobile associations or clubs. Table 10 provides the results using the summative index to identify Michigan snowmobilers' subgroups.

Table 10 Summative Index Result for Snowmobilers' Recreational Specialization

Subgroup	Variable	Mean	S.D.
Novice	Numbers of snowmobiles owned	1.7	0.7
(N = 269)	Money spent in the last 12 months ($)	539.1	1162.2
	Snowmobiling experience	0.45	0.24
	Snowmobile days in winter 07-08	11.1	8.0
	Miles driven in winter 07-08	647.9	509.8
	Snowmobile membership	0.1	0.2
Intermediate	Numbers of snowmobiles owned	2.4	0.87
(N = 269)	Money spent in the last 12 months ($)	1129.9	1739.1
	Snowmobiling experience	0.62	0.19
	Snowmobile days in winter 07-08	18.2	12.3
	Miles driven in winter 07-08	1277.0	805.0
	Snowmobile membership	0.3	0.5
Expert	Numbers of snowmobiles owned	3.3	1.1
(N = 269)	Money spent in the last 12 months ($)	4192.0	4814.4
	Snowmobiling experience	0.69	0.18
	Snowmobile days in winter 07-08	33.3	23.1
	Miles driven in winter 07-08	2707.2	1516.9
	Snowmobile membership	0.5	0.6

To test research hypothesis one: There is no difference in group composition across levels of specialization using summative indices and cluster analysis, the examination of the differences among three snowmobile subgroups is warranted. A boxplot and Shapiro-Wilk's normality test were performed to assess if the underlying assumptions of the one-way ANOVA were met. The boxplot result showed that there were outliers in each of the three subgroups for

money spent in the past 12 months, snowmobile days in winter of 2007-08, and miles driven in the winter of 2007-08. The normality test also revealed that data of all six specialization variables in each subgroup were not normally distributed ($p < .05$). Therefore, the non-parametric equivalent of Kruskal-Wallis test was run to determine if there were differences in each of the specialization variables among the novice, intermediate, and expert snowmobiler subgroups. Statistical significance was accepted at the $p < .05$ level for the omnibus test and $p < .0167$ level for the multiple comparisons (.05 divided by 3). Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons.

The results showed that the number of snowmobiles owned was significantly different among the three subgroups of recreational specialization: χ^2 (2) = 275.235, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in numbers of snowmobiles owned between the novice (Mean = 1.7) and intermediate snowmobilers (Mean = 2.4; $p < .0005$), intermediate (Mean = 2.4) and expert snowmobilers (Mean = 3.3; $p < .0005$), and novice and expert snowmobilers ($p < .0005$).

Money spent on snowmobiling in the last 12 months was significantly different among the three subgroups of recreational specialization: χ^2 (2) = 209.313, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in money spent in the last 12 months between the novice (Mean = 539.1) and intermediate snowmobilers (Mean = 1129.9; $p < .0005$), intermediate (Mean = 1129.9) and expert snowmobilers (Mean = 4192.0; $p < .0005$), and novice and expert snowmobilers ($p < .0005$).

Snowmobile experience was significantly different among the three subgroups of recreational specialization: χ^2 (2) = 141.595, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in snowmobile experience between novice (Mean = .45) and intermediate snowmobilers (Mean = .62; $p < .0005$), intermediate (Mean = .62) and expert snowmobilers (Mean = .69; $p < .0005$), and novice and expert snowmobilers ($p < .0005$).

Snowmobile days in winter 2007-08 were significantly different among the three subgroups of recreational specialization: χ^2 (2) = 253.814, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in snowmobile days in winter 2007-08 between the novice (Mean = 11.1) and intermediate snowmobilers (Mean = 18.2; $p < .0005$), intermediate (Mean = 18.2) and expert snowmobilers (Mean = 33.3; $p < .0005$), and novice and expert snowmobilers ($p < .0005$).

Miles driven in winter 2007-08 were significantly different among the three subgroups of recreational specialization: χ^2 (2) = 387.970, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in miles driven in winter 2007-08 between the novice (Mean = 647.9) and intermediate snowmobilers (Mean = 1277.0; $p < .0005$), intermediate (Mean = 1277.0) and expert snowmobilers (Mean = 2707.2; $p < .0005$), and novice and expert snowmobilers ($p < .0005$).

Snowmobile membership was also significantly different among the three subgroups of recreational specialization: χ^2 (2) = 117.472, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in snowmobile membership between the novice (Mean = .1) and intermediate snowmobilers (Mean = .3; $p < .0005$), intermediate (Mean = .3) and expert snowmobilers (Mean = .5; $p < .0005$), and novice and expert snowmobilers ($p < .0005$). Table 11

presents the result of the *post-hoc* analysis for summative index method of identifying recreational specialization subgroups.

Table 11 Pairwise Comparison Result of Summative Index for Snowmobilers' Specialization

	Specialization Subgroups			
Variable	Novice	Intermediate	Expert	χ^2 (*sig.*)
Numbers of snowmobiles owned	ac	ab	bc	275.235**
Money spent in the last 12 months	ac	ab	bc	209.313**
Snowmobiling experience	ac	ab	bc	141.595**
Snowmobile days in winter 07-08	ac	ab	bc	253.814**
Miles driven in winter 07-08	ac	ab	bc	387.970**
Snowmobile membership	ac	ab	bc	117.472**

ac,ab,bc Groups with a same letter were significantly different at the .05 level of confidence
*** = Significant at the .001 level*

In total, the summative index method displayed a logical recreational specialization continuum for Michigan snowmobilers as expert snowmobilers showed the highest commitment in all six specialization measures, while novice snowmobilers committed the least (Figure 12). The Kruskal-Wallis test and *post-hoc* results showed that there were statistically significant differences on behavior, skill/knowledge, and psychological attachment characteristics among novice, intermediate, and expert snowmobilers. For each of the six recreational specialization variables, the three subgroups also revealed distinct differences from the other subgroups.

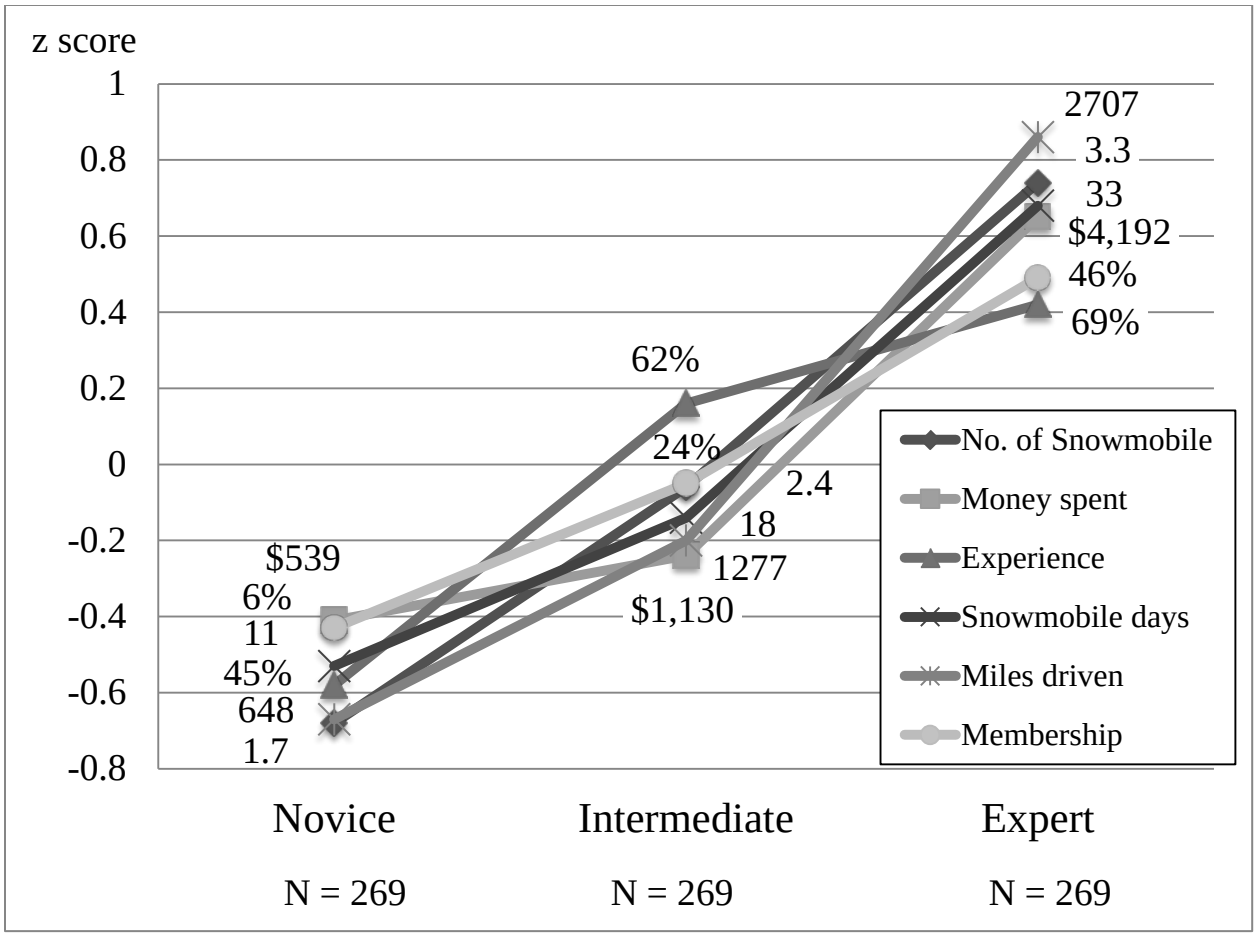

Figure 12 Michigan Snowmobiler Recreational Specialization – Summative Index Result

Cluster Analysis for Recreational Specialization

K-mean cluster analysis was performed to identify subgroups with similar characteristics. Three subgroups, moderates, big spenders, and trail warriors, were identified and named based on their within-group features. The results of cluster analysis showed that there were 194 trail warriors (24%), 89 big spenders (11%), and 524 moderate snowmobilers (65%). In general, moderate snowmobilers owned 2 snowmobilers, spent 686 dollars on snowmobile related items such as maintenance and insurance in the previous 12 months, had snowmobiled for 55% of their life, and rode about 14 days traveling 890 miles in the winter of 2007-08. About 19% of them belonged to one or more snowmobile associations or clubs.

Big spenders on average owned 3 snowmobiles, had snowmobiled for 63% of their life, and rode 27 days traveling 2,058 miles in the winter of 2007-08. About 31% of them participated in one or more snowmobile associations or clubs. Particularly, these big spenders spent on average 10,398 dollars for snowmobiling related items that may have included purchase of a snowmobile, snowmobile equipment, snowmobile repair/maintenance, insurance on the snowmobile(s), and off-season storage costs. Of these 89 big spenders, 84 (94%) purchased a snowmobile in the past 12 months, spending 8,398 dollars for the machine.

Table 12 Cluster Analysis Result for Snowmobilers' Recreational Specialization

Subgroup	Variable	Mean	S.D.
Moderate	Numbers of snowmobiles owned	2.0	.8
(N = 524)	Money spent in the last 12 months ($)	685.9	1062.7
	Snowmobiling experience	.55	.24
	Snowmobile days in winter 07-08	13.9	9.7
	Miles driven in winter 07-08	899.6	634.8
	Snowmobile membership	.2	.4
Big Spender	Numbers of snowmobiles owned	3.0	1.1
(N = 89)	Money spent in the last 12 months ($)	10398.2	3560.9
	Snowmobiling experience	.63	.23
	Snowmobile days in winter 07-08	27.0	19.4
	Miles driven in winter 07-08	2058.3	1213.4
	Snowmobile membership	.4	.6
Trail Warrior	Numbers of snowmobiles owned	3.3	1.1
(N = 194)	Money spent in the last 12 months ($)	1503.7	1638.6
	Snowmobiling experience	.66	.18
	Snowmobile days in winter 07-08	37.0	23.7
	Miles driven in winter 07-08	3048.7	1507.3
	Snowmobile membership	.4	.6

The trail warriors generally owned slightly more than 3 sleds, spent 1,504 dollars on snowmobiling maintenance, insurance, and other related items, had snowmobiled for 66% of their life, and rode 37 days traveling 3,049 miles in the winter of 2007-08. About 40% of them belonged to one or more snowmobile associations or clubs. Table 12 shows the result for using K-mean cluster analysis to identify Michigan snowmobilers' subgroups.

To test research hypothesis one: There is no difference in group composition across levels of specialization using summative indices and cluster analysis, examination of the differences among the three snowmobile subgroups is warranted. A boxplot and Shapiro-Wilk's normality test were performed to assess if the underlying assumptions of the one-way ANOVA were met. The boxplot result showed that there were outliers in money spent in the past 12 months and snowmobile memberships. The normality test also revealed that data of all six specialization variables in each subgroup were not normally distributed ($p < .05$). Therefore, the non-parametric equivalent of the Kruskal-Wallis test was again performed to decide if there were differences in each of the specialization variables among moderate, big spender, and trail warrior snowmobilers. Statistical significance was accepted at the $p < .05$ level for the omnibus test and $p < .0167$ level for the multiple comparisons (.05 divided by 3).

Pairwise comparisons result showed that numbers of snowmobiles owned was significantly different among the three subgroups: χ^2 (2) = 212.894, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in numbers of snowmobiles owned between the moderates (Mean = 2.0) and big spenders (Mean = 3.0; $p < .0005$) and moderates (Mean = 2.0) and trail warriors (Mean = 3.3; $p < .0005$). There was no significant difference between trail warrior and big spender snowmobilers.

Money spent in the last 12 months was statistically different among the three subgroups: χ^2 (2) = 300.272, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in money spent in the last 12 months between the moderates (Mean = 685.9) and big spenders (Mean = 10398.2; $p < .0005$), big spenders (Mean = 10398.2) and trail warriors (Mean = 1503.7; $p = .000$), and moderate and trail warrior snowmobilers ($p < .0005$).

Snowmobile experience was significantly different among the subgroups: χ^2 (2) = 39.845, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in numbers of snowmobiles owned between the moderates (Mean = .55) and big spenders (Mean = .63; $p < .0005$) and moderates (Mean = .55) and trail warriors (Mean = .66; $p < .0005$). There was no significant difference between trail warrior and big spender snowmobilers.

Snowmobile days in winter 2007-08 was statistically significantly different among the three subgroups, χ^2 (2) = 254.678, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in snowmobile days in winter 2007-08 between the moderates (Mean = 13.9) and big spenders (Mean = 27.0; $p < .0005$), big spenders (Mean = 27.0) and trail warriors (Mean = 37.0; $p = .001$), and moderate and trail warrior snowmobilers ($p < .0005$).

Miles driven in winter 2007-08 was significantly different among the three subgroups: χ^2 (2) = 374.389, $p < .0005$. *Post-hoc* analysis revealed statistically significant differences in miles driven in winter 2007-08 between the moderates (Mean = 899.6) and big spenders (Mean = 2058.3; $p < .0005$), big spenders (Mean = 2058.3) and trail warriors (Mean = 3048.7; $p = .001$), and moderate and trail warrior snowmobilers ($p < .0005$).

Snowmobile membership was significantly different among the subgroups: χ^2 (2) = 38.476, $p < .0005$. *Post-hoc* analysis revealed significant differences between the moderates (Mean = .2) and big spenders (Mean = .4; $p = .029$) and moderates (Mean = .2) and trail warriors (Mean = .4; $p < .0005$). There was no significant difference between trail warrior and big spender snowmobilers. Table 13 presents the result of the *post-hoc* analysis for K-mean cluster analysis method of identifying recreational specialization subgroups.

Table 13 Pairwise Comparison Result of Cluster Analysis for Snowmobilers' Specialization

Variable	Specialization Subgroups			χ^2 (*sig.*)
	Moderate	Big Spender	Trail Warrior	
Numbers of snowmobiles owned	ab	a	b	212.894**
Money spent in the last 12 months ($)	ac	ab	bc	300.272**
Snowmobiling experience	ab	a	b	39.845**
Snowmobile days in winter 07-08	ac	ab	bc	254.678**
Miles driven in winter 07-08	ac	ab	bc	374.389**
Snowmobile membership	ab	a	b	38.476**

a,b,ab,ac Groups with a same letter were significantly different at the .05 level of confidence
*** = Significant at the .001 level*

In summary, the cluster analysis approach did not present as smooth a recreational specialization continuum along all dimensions as the summative index method did for Michigan snowmobilers (Figure 13). However, the group composition of moderate, big spender, and trail warrior snowmobilers illustrated different aspects of Michigan snowmobilers with unique and statistically significant different behavior, skill/knowledge, and psychological attachment characteristics. While the differences among moderates, big spenders, and trail warriors were statistically significant, the *post-hoc* analysis results showed no apparent differences between big spenders and trail warriors on numbers of snowmobiles owned, snowmobiling experience, and snowmobile organization memberships. However, 94% of the big spenders purchased a snowmobile in the snowmobile season 2007-08, which differentiated big spenders from trail warriors. Other than the money spent in the past 12 months, the *post-hoc* analysis results also showed significant differences between big spenders and trail warriors on snowmobile days in winter 2007-08 and miles driven in winter 2007-08. The distinct behavior, skill/knowledge, and psychological attachment characteristics were evident among moderate, trail warrior, and big spender snowmobilers.

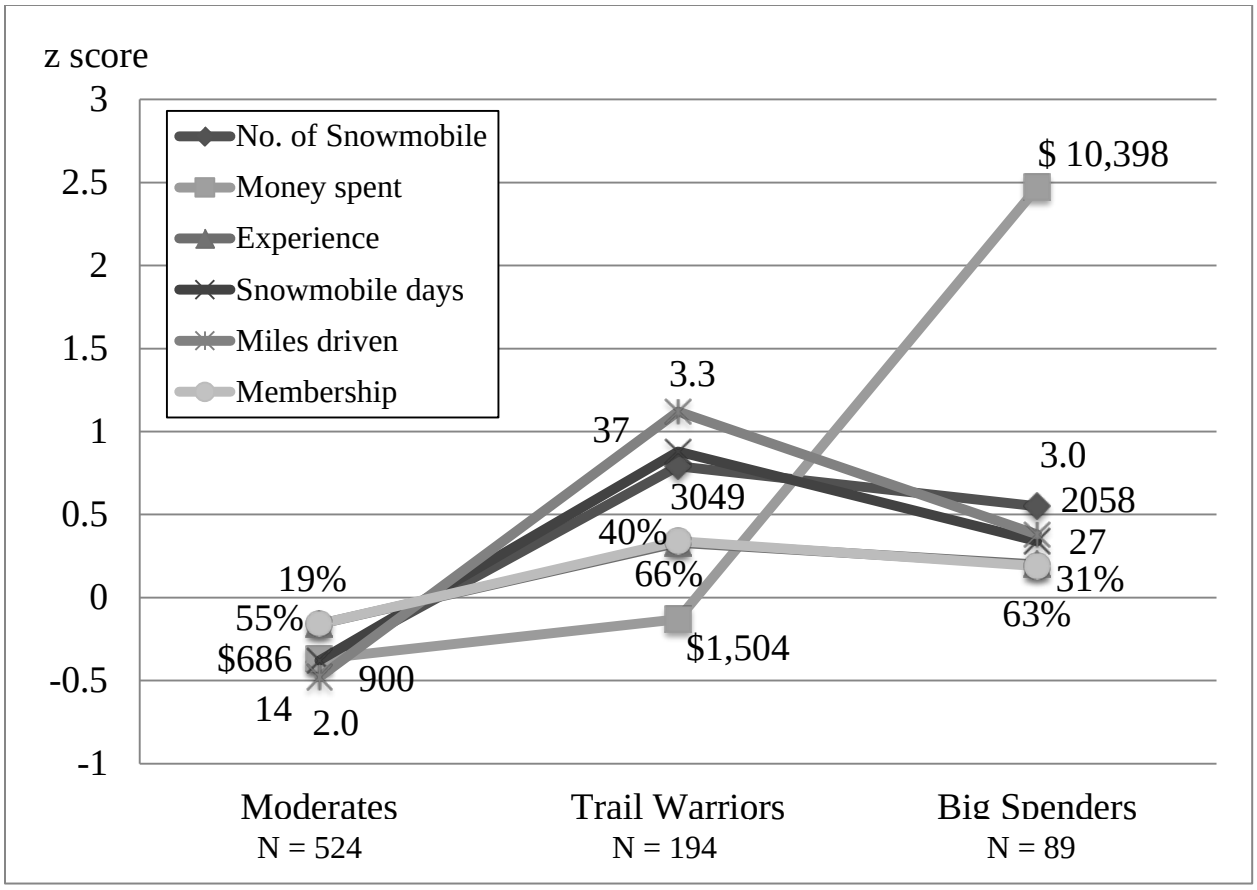

Figure 13 Michigan Snowmobiler Recreational Specialization – Cluster Analysis Result

Summary of Comparison of Summative Index and Cluster Analysis

Both the summative index method and the cluster analysis approach generated significantly different levels of specialized Michigan snowmobilers. However, group composition across levels of specialization between the two methods appeared to be dissimilar. Novice, intermediate, and expert snowmobilers presented different behavior, skill/knowledge, and psychological attachment characteristics than did moderate, big spender, and trail warrior snowmobilers. For this reason, the research rejected the null hypothesis one and concluded that there were differences in group composition across levels of specialization between the summative index method and the cluster analysis.

To address research question one, the results of the summative index and cluster analysis showed unique features of Michigan snowmobilers who purchased a trail permit in the winter of 2007-08. The summative index results described three distinct subgroups in the snowmobiler social world: novice, intermediate, and expert. They revealed significant differences in their behavioral, skill/knowledge, and psychological attachment characteristics. While novice snowmobilers owned the least numbers of snowmobiles, spent just 539 dollars for their 11 days and 648 miles of snowmobiling experience, expert snowmobilers on average owned 3 sleds, spent 4,192 dollars for their 33 days of snowmobiling experience traveling 2,707 miles on their sled. It is clear that more specialized snowmobilers presented more intensive behavioral commitment (snowmobiles owned, money spent, and snowmobiling experience), knowledge/skill (snowmobile days and mileage), and psychological attachment (snowmobile organization membership) to the activity compared to less specialized snowmobilers. Expert snowmobilers were more specialized than intermediate and novice snowmobilers, just as intermediate snowmobilers showed a higher level of snowmobiling specialization than novice snowmobilers.

On the other hand, the cluster analysis described different aspects of the within group social world of Michigan snowmobilers. Three subgroups of recreational specialization, moderates (65%), big spenders (11%), and trail warriors (24%), revealed significantly different behavior, skill/knowledge, and psychological attachment characteristics. Unlike the three subgroups identified by the summative index method, moderates, big spenders, and trail warriors did not appear to be as hierarchical as novice, intermediate, and expert snowmobilers. The majority of the Michigan snowmobilers were moderates, who casually participated in the activity with the least number of snowmobiles owned (2 sleds), money spent on snowmobiling related

items ($686), snowmobile experience (55%), snowmobile days (14), miles driven (900), and participation in snowmobile organization membership (19%). The rest of the snowmobilers were divided into two groups with unique features in money spent, snowmobile days, and miles driven. Big spenders spent a significant amount of money ($10,398) on snowmobiling related items such as snowmobile purchase, insurance, repair/maintenance, and storage. They rode significantly less days and fewer miles in the winter of 2007-08 compared to trail warriors, who rode 37 days traveling 3,049 miles and spent 1,504 dollars on snowmobiling related items. There were no significant differences between big spenders and trail warriors on number of snowmobiles owned, snowmobiling experience, and organization membership.

Based on these results, it is considered that the combination of novice, intermediate, and expert snowmobiling subgroups best represents the continuous nature of Michigan snowmobiling recreational specialization. Not only because all aspects of the six specialization variables were significantly different among the three subgroups, but the distribution of the three subgroups also fits the original assumptions of the recreational specialization continuum proposed by Bryan (1977). The influences of specialization on the perception of risks and spatial interaction were then assessed by the results identified by the summative index method. The following research findings were based on the difference among novice, intermediate, and expert snowmobilers.

Influence of Specialization on the Perception of Risk

Previous studies showed mixed results on recreationalists' characteristics and their perception of risks. To address research question two: what are the relationships between levels of recreational specialization and snowmobilers' perception of risk, MANOVA and an effect size index Eta (η) were run to test null hypotheses two to ten:

H_2: There is no relationship between snowmobilers' recreational specialization and their perception of operating a snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol).

H_3: There is no relationship between snowmobilers 'recreational specialization and their perception of operating a snowmobile by a legally intoxicated person (0.08 or higher blood alcohol).

H_4: There is no relationship between snowmobilers 'recreational specialization and their perception of speed of snowmobile.

H_5: There is no relationship between snowmobilers 'recreational specialization and their perception of driver lacking skill in operating machine.

H_6: There is no relationship between snowmobilers 'recreational specialization and their perception of cars/trucks on seasonal roads.

H_7: There is no relationship between snowmobilers 'recreational specialization and their perception of public trail conditions.

H_8: There is no relationship between snowmobilers 'recreational specialization and their perception of public trail design.

H_9: There is no relationship between snowmobilers 'recreational specialization and their perception of other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing).

H_{10}: There is no relationship between snowmobilers 'recreational specialization and their perception of snowmobiling on county/state road shoulders.

The MANOVA was run to determine the effect of the level of recreational specialization on Michigan snowmobilers' perception of risks. Nine measures of perceived risk were assessed: operation of snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol); operation of snowmobile by a legally intoxicated person (0.08 or higher blood alcohol); speed of snowmobile; driver lacking skill in operating machine; cars/trucks on seasonal roads; public trail conditions; public trail design; other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing); and snowmobiling on county/state road shoulders. Snowmobilers were categorized into three subgroups based on their recreational specialization: Novice, Intermediate, and Expert.

Multiple preliminary tests were run to make sure the underlying assumptions of one-way MANOVA were met. To test the multivariate normality assumption, Shapiro-Wilk's test ($p > .05$) was performed on all nine perceptions of risk. Despite the fact that the normality assumption was violated, analysis proceeded because: 1) One-way MANOVA is fairly robust to deviations from normality, particularly if the sample size in each subgroup is equal, or nearly equal, as is the case here (Lix, Keselman & Keselman, 1996). 2) The sample size of each recreational specialization subgroup (n = 269) is fairly large, thus the skewed distributions are not problematic (Sawilowsky & Blair, 1992). Further, the result of detecting outliers showed that there were no extreme univariate outliers in the data, as assessed by inspection of a boxplot. However, six cases were defined as multivariate outliers as assessed by Mahalanobis distance ($p > .001$). To meet the assumption, those six cases were omitted from the analyses that followed.

For the assumption of multicollinearity, Pearson's correlation showed that the assumption was not violated. Finally, there was homogeneity of variance-covariance matrices, as assessed by Box's M test of equality of covariance matrices (p = .363).

Overall, novice, intermediate, and expert snowmobilers shared very similar perceptions toward nine snowmobile riding risks. They considered "Operation of snowmobile by a legally intoxicated person" (4.4, 4.4, and 4.4), "Driver lacking skill in operating machine" (4.0, 4.1, and 4.1), and "Speed of snowmobile" (3.9, 3.8, and 3.6) highly dangerous. A further review showed that novice snowmobilers perceived slightly lower danger on "Driver lacking skill in operating machine" compared to intermediate and expert snowmobilers. Conversely, when asked their perceptions on "Speed of snowmobile," less specialized snowmobilers generally perceived higher risk than those more specialized snowmobilers.

Michigan snowmobilers considered "Operation of snowmobile by person who has been drinking but is not legally intoxicated" (3.2, 3.3, and 3.3), (2.9, 3.3, and 3.3), and "Other uses of designated snowmobile trails" (2.7, 2.9, and 2.8) moderately dangerous. Novice snowmobilers perceived less risk when "Operation of snowmobile by person who has been drinking but is not legally intoxicated" and "Cars/trucks on seasonal roads" compared to intermediate and expert snowmobilers. A mixed perception of risk was found among snowmobilers when asked to rate "Other uses of designated snowmobile trails." Intermediate snowmobilers perceived the highest risk, while novice snowmobilers perceived the least.

Table 14 Michigan Snowmobilers' Perception of risks by Specialization Subgroup

Perception of Risk	Specialization Subgroups	Mean	S.D.
Operation of snowmobile by a legally intoxicated person (0.08 or higher blood alcohol)	Novice	4.4	1.0
	Intermediate	4.4	1.0
	Expert	4.4	.9
Operation of snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol)	Novice	3.2	1.4
	Intermediate	3.3	1.4
	Expert	3.3	1.4
Speed of snowmobile	Novice	3.9	1.1
	Intermediate	3.8	1.1
	Expert	3.6	1.1
Driver lacking skill in operating machine	Novice	4.0	1.1
	Intermediate	4.1	1.0
	Expert	4.1	1.0
Cars/trucks on seasonal roads	Novice	2.9	1.2
	Intermediate	3.2	1.1
	Expert	3.2	1.2
Public trail conditions	Novice	2.4	1.0
	Intermediate	2.4	1.1
	Expert	2.3	1.0
Public trail design	Novice	2.2	1.0
	Intermediate	2.2	1.0
	Expert	2.0	1.0
Other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing)	Novice	2.7	1.2
	Intermediate	2.9	1.3
	Expert	2.8	1.4
Snowmobiling on county/state road shoulders	Novice	2.2	1.0
	Intermediate	2.2	1.1
	Expert	2.2	1.0

Lastly, novice, intermediate, and expert snowmobilers considered "Public trail conditions" (2.4, 2.4, and 2.3), "Snowmobiling on county/state road shoulders" (2.2, 2.2, and 2.2), and "Public trail design" (2.2, 2.2, 2.0) only slightly dangerous. Table 14 presents the descriptive statistics of nine perceptions of risk among the three snowmobile recreational specialization subgroups.

The MANOVA results showed that there was an overall statistically significant difference among the snowmobile recreational specialization subgroups, F (9, 791) = 2.136, p =

.0004; Wilks' Λ = .953; partial η^2 = .024. Follow-up univariate ANOVAs found that "Speed of snowmobile" (F (2, 798) = 5.024, p = .007) and "Cars/trucks on seasonal roads" (F (2, 798) = 5.109, p = .006) were significantly different among the snowmobilers from different specialization subgroups, using a Bonferroni test with an adjusted α level of .025.

The Tukey *post-hoc* tests showed that novice snowmobilers perceived significantly higher risk on "Speed of snowmobile" than expert snowmobilers (p = .005). No statistical significant differences were found between novice and intermediate snowmobilers (p = .426) or intermediate and expert snowmobilers (p = .139). For "Cars/trucks on seasonal roads," *post-hoc* tests indicated that novice snowmobilers perceived significantly lower risk than either intermediate (p = .017) or expert snowmobilers (p = .015). However, no statistically significant difference was found between intermediate and expert snowmobilers (p = .999).

The effect size index Eta (η) was run to assess the relationship between recreational specialization and nine perceptions of risk. Overall, the effects of recreational specialization on perception of risk were very weak. A negative weak relationship was found between recreational specialization and the perceptions of "Speed of snowmobile" (η = .112), while a positive weak relationship was found between recreational specialization and "Cars/trucks on seasonal roads" (η = .112). Partial eta squared (η_p^2) indicated that recreational specialization only explained 1.2% of the variance and the associated errors of "Speed of snowmobile" (η_p^2 = .012) and 1.3% of the variance and the associated errors of "Cars/trucks on seasonal roads" (η_p^2 = .013). For the other seven risk items, recreational specialization explained 0.2% of the variance of "Operation of snowmobile by person who has been drinking but is not legally intoxicated," 0.1% of "Operation of snowmobile by a legally intoxicated person," 0.6% of "Driver lacking skill in operating

machine," 0.1% of "Public trail conditions," 0.3% of "Public trail design," 0.3% of "Other uses of designated snowmobile trails," and less than 0.01% of "Snowmobiling on county/state road shoulders." Table 15 presents the comparison result for nine perceptions of risks across three levels of recreational specialization.

Table 15 Comparison of Perception of Risk Across Specialization Subgroups

Perception of Risks	Specialization Subgroups					
Variable	Novice	Intermediate	Expert	F ($sig.$)	η	η_p^2
Operation of snowmobile by person who has been drinking but is not legally intoxicated				.852	.046	.002
Operation of snowmobile by a legally intoxicated person				.359	.030	.001
Speed of snowmobile	a		a	5.024*	.112	.012
Driver lacking skill in operating machine				2.292	.076	.006
Cars/trucks on seasonal roads	ab	a	b	5.109*	.112	.013
Public trail conditions				.327	.029	.001
Public trail design				1.121	.053	.003
Other uses of designated snowmobile trails				1.146	.054	.003
Snowmobiling on county/state road shoulders				.138	.019	.000

a,b,ab Groups with a same letter were significantly different at the .05 level of confidence
** = Significant at the .05 level*

The MONOVA and effect size index Eta results showed no evidence of a significant relationship existing between levels of recreational specialization and the risk perception of operating a snowmobile by a person who has been drinking but is not legally intoxicated. Therefore, the research failed to reject the null hypothesis two and concluded that there is no relationship between level of recreational specialization and the risk perceptions of "operating a snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol)."

The MONOVA and effect size index Eta results showed no evidence of a significant relationship exist between levels of recreational specialization and the risk perception of

operating a snowmobile by a legally intoxicated person. Therefore, the research failed to reject the null hypothesis three and concluded that there is no relationship between level of recreational specialization and the risk perceptions of “operating a snowmobile by a legally intoxicated person (0.08 or higher blood alcohol).”

The MONOVA and effect size index Eta results showed a significant relationship exists between levels of recreational specialization and the risk perception of speed of the snowmobile. Levels of recreational specialization explained 1.2% of the variance and the associated errors of “speed of snowmobile.” Therefore, the research rejected the null hypothesis four and concluded that there is a negative weak relationship between level of recreational specialization and the risk perceptions of “speed of snowmobile.”

The results from MONOVA and effect size index Eta tests showed no evidence of a significant relationship exist between levels of recreational specialization and the risk perception of a driver lacking skill in operating his/her machine. Therefore, the research failed to reject the null hypothesis five and concluded that there is no relationship between level of recreational specialization and the risk perceptions of “driver lacking skill in operating machine.”

The MONOVA and effect size index Eta results showed a significant relationship exist between levels of recreational specialization and the risk perception of cars/truck on seasonal roads. Levels of recreational specialization explained 1.3% of the variance and the associated errors of “cars/truck on seasonal roads.” Therefore, the research rejected the null hypothesis six and concluded that there is a positive weak relationship between level of recreational specialization and the risk perceptions of “cars/truck on seasonal roads.”

The results from MONOVA and effect size index Eta tests showed no evidence of a significant relationship exist between levels of recreational specialization and the risk perception of public trail conditions. Therefore, the research failed to reject the null hypothesis seven and concluded that there is no relationship between level of recreational specialization and the risk perceptions of “public trail conditions.”

The MONOVA and effect size index Eta results showed no evidence of a significant relationship exist between levels of recreational specialization and the risk perception of public trail design. Therefore, the research failed to reject the null hypothesis eight and concluded that there is no relationship between level of recreational specialization and the risk perceptions of “public trail design.”

The results from MONOVA and effect size index Eta tests showed no evidence of a significant relationship exist between levels of recreational specialization and the risk perception of other uses of designated snowmobile trails. Therefore, the research failed to reject the null hypothesis nine and concluded that there is no relationship between level of recreational specialization and the risk perceptions of “other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing).”

The MONOVA and effect size index Eta results showed no evidence of a significant relationship between levels of recreational specialization and the risk perception of snowmobiling on county/state road shoulders. Therefore, the research failed to reject the null hypothesis ten and concluded that there is no relationship between level of recreational specialization and the risk perceptions of “snowmobiling on county/state road shoulders.”

In sum, null hypotheses two, three, five, seven, eight, and nine were rejected. However, there was no meaningful influence of recreational specialization on snowmobilers' perception of risks. Despite the characteristic differences among novice, intermediate, and expert snowmobilers, there were minimal differences in key perceived snowmobiling risks. The only statistically significant differences among snowmobiler subgroups were found on perceptions of "Speed of snowmobile" and "Cars/trucks on seasonal roads." In general, those categorized as novice perceived the highest risk on "Speed of the snowmobile" compared to expert snowmobilers. When asked about the perceived risk on "Cars/trucks on seasonal roads" while snowmobiling, novice snowmobilers perceived significantly lower risk compared to intermediate or expert snowmobilers. No significant difference was found between intermediate and expert snowmobilers. Moreover, a negative weak relationship was found between levels of recreational specialization and the risk perception "Speed of snowmobile" and a positive weak relationship was found between levels of specialization and the risk perception "Cars/trucks on seasonal roads."

Influence of Specialization on Spatial Interaction

The literature suggests an association between leisure participation and spatial interaction. Since the level of recreational specialization measured in this research is heavily based on recreationists' snowmobiling participation, level of specialization is assumed to be correlated with spatial interaction between snowmobilers' residential origin and destination, the snowmobile trail network. To address research question three: What are the relationships between levels of recreational specialization and snowmobilers' spatial interaction with snowmobile trail network, ANOVA and an effect size index Eta (η) were run to test null hypothesis 11:

H_{11}: There is no relationship between levels of recreational specialization and snowmobilers' spatial interaction with the snowmobile trail network.

Spatial Interaction Result by Destination Regions

One-way ANOVA was used to test differences across levels of specialization in snowmobilers' spatial interaction with the snowmobile trail network. A boxplot and Shapiro-Wilk's normality test were performed to assess if the underlying assumptions of one-way ANOVA were met. The boxplot result showed that there were extreme outliers in all three Michigan snowmobile recreational specialization subgroups. The normality test also revealed that spatial interaction data in each subgroup were not normally distributed ($p < .05$). Therefore, the non-parametric equivalent of the Kruskal-Wallis test was run to decide if there were differences among novice, intermediate, and expert snowmobilers. Statistical significance was accepted at the $p < .05$ level for the omnibus test and $p < .0167$ level for the multiple comparisons (.05 divided by 3). A *post-hoc* analysis was performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons.

Spatial interaction measures the flow between locations; therefore the results of spatial interaction between Michigan snowmobilers and their five destination regions were presented using the summation value instead of the mean in the following paragraphs. Additionally, since the spatial interaction results were highly skewed and not normally distributed, the mean rank scores were utilized instead of mean score to report the strength of spatial interaction. The SPSS program did not generate the mean rank scores for those destination regions with no significant differences among specialization subgroups. A higher ranking score indicates a stronger spatial interaction between origin and destination.

Table 16 Spatial Interaction between Michigan Snowmobilers and Five Regions

Destination Region	Specialization Subgroups	Mean Rank	Median	Sum	S.D.
Region 1*	Novice	388.67	.0	2821.9	112.6
	Intermediate	388.65	.0	2455.4	93.8
	Expert	434.68	.0	4051.9	206.7
Region 2*	Novice	366.84	.0	2552.2	89.5
	Intermediate	377.55	.0	24173.1	1299.2
	Expert	467.62	.5	5465.7	155.4
Region 3	Novice	N/A	.5	6205.3	88.0
	Intermediate	N/A	2.6	12380.0	512.2
	Expert	N/A	2.0	6464.5	133.2
Region 4*	Novice	375.88	.0	3692.7	100.2
	Intermediate	423.99	.0	4720.9	71.6
	Expert	412.12	.0	57333.5	3189.7
Region 5	Novice	N/A	.0	2423.2	68.4
	Intermediate	N/A	.0	2737.2	76.5
	Expert	N/A	.0	1551.4	28.5

* = *Significant at the .05 level*

The Kruskal-Wallis result showed that spatial interaction between Michigan snowmobilers and region one (χ^2 (2) = 14.363, p = .001), two (χ^2 (2) = 39.510, p < .0005), and four (χ^2 (2) = 7.970, p = .019) were significantly different among novice, intermediate, and expert snowmobilers. Table 16 shows the descriptive result for spatial interaction between Michigan snowmobilers and five destination regions.

For interaction between all snowmobilers and region one, *post-hoc* analysis revealed statistically significant differences between expert snowmobilers and novice snowmobilers (p = .003), and expert and intermediate snowmobilers (p = .003). The mean rank scores showed that expert snowmobilers had significant higher spatial interaction with the snowmobile trail network in region one compared to novice and intermediate snowmobilers. There was no statistically significant difference between novice and intermediate snowmobilers (p = 1.000).

For spatial interaction between snowmobilers and region two, *post-hoc* analysis showed that there were significant differences between expert and novice snowmobilers (p < .0005), and

expert and intermediate snowmobilers ($p < .0005$). The mean rank scores showed that expert snowmobilers had significant higher spatial interaction with the snowmobile trail network in region two compared to intermediate and novice snowmobilers. No significant differences were found between novice and intermediate snowmobilers ($p = 1.000$).

Finally, for spatial interaction between snowmobilers and region four, *post-hoc* analysis showed that there were statistically significant differences between novice and intermediate snowmobilers ($p = .020$). The mean rank scores showed that intermediate snowmobilers had the highest spatial interaction with the snowmobile trail network in region four and the interaction was significantly higher than that of novice snowmobilers. No significant differences were found between expert and novice ($p = .124$) or expert and intermediate snowmobilers ($p = 1.000$). Table 17 presents the comparison result of spatial interaction among novice, intermediate, and expert snowmobilers.

Table 17 Comparison Result of Spatial Interaction Among Specialization Subgroups

	Specialization Subgroups			
Destination Region	Novice	Intermediate	Expert	χ^2 (*sig.*)
Spatial Interaction with Region 1	a	b	ab	14.636*
Spatial Interaction with Region 2	a	b	ab	39.510*
Spatial Interaction with Region 3				2.382
Spatial Interaction with Region 4	a	a		7.970*
Spatial Interaction with Region 5				.338

a,b,ab Groups with a same letter were significantly different at the .05 level of confidence.
** = Significant at the .05 level*

Spatial Interaction Result by Snowmobilers' Residential Regions

Research has indicated that the spatial structure of locations varies from one origin to another (Fesenmaier & Lieber, 1985). The spatial interaction between Michigan snowmobilers and the trail network in each destination region was examined by dividing snowmobilers based on their residential regions. The non-parametric equivalent of Kruskal-Wallis test as well as *post-*

hoc analysis were again run for each residential region to decide if there were differences among novice, intermediate, and expert snowmobilers.

Table 18 Spatial Interaction between Region One and Two Snowmobilers and Trail Network

Residential Region	Destination Region	Recreational Specialization	Median	Sum	S.D.
Region 1 (western Upper Peninsula)	Region 1	Novice	66.4	2768.9	486.5
		Intermediate	77.0	2425.5	446.4
		Expert	67.2	3980.8	1167.1
	Region 2	Novice	.0	10.6	2.6
		Intermediate	.0	7.2	2.0
		Expert	.3	11.5	2.0
	Region 3	Novice	.0	.0	.0
		Intermediate	.0	.0	.0
		Expert	.0	.0	.0
	Region 4	Novice	.0	.0	.0
		Intermediate	.0	.0	.0
		Expert	.0	.0	.0
	Region 5	Novice	.0	.0	.0
		Intermediate	.0	.0	.0
		Expert	.0	.0	.0
Region 2 (eastern Upper Peninsula)	Region 1	Novice	.0	23.6	6.8
		Intermediate	.0	8.5	3.0
		Expert	.0	34.0	6.7
	Region 2	Novice	87.2	2236.2	448.6
		Intermediate	34.9	23926.2	7396.6
		Expert	70.2	4989.1	623.2
	Region 3	Novice	.0	.0	.0
		Intermediate	.0	.0	.0
		Expert	.0	.0	.0
	Region 4	Novice	.0	.0	.0
		Intermediate	.0	.0	.0
		Expert	.0	.0	.0
	Region 5	Novice	.0	.0	.0
		Intermediate	.0	.0	.0
		Expert	.0	.0	.0

Based on the Kruskal-Wallis test results, there were no statistically significant differences among specialization subgroups on the spatial interaction between either region one or region two snowmobilers and their destination regions. However, statistically significant differences were found for region three, four, and five snowmobilers' spatial interaction with different

destinations. Table 18 shows the descriptive result of spatial interaction between region one and region two Michigan snowmobilers and their five destination regions.

For the relationship between recreational specialization and spatial interaction, the result of the effect size index Eta (η) indicated that there were weak relationships between the two concepts when snowmobilers who lived in region one travel to region two or stayed in their residential region. For snowmobilers who lived in region two, there was a weak relationship when they traveled to region one for snowmobiling. There was a moderate relationship between recreational specialization and spatial interaction when region two snowmobilers staying at their own residential region for the activity. Overall, recreational specialization accounted for 10% or less of the spatial interaction variance for snowmobilers lived in the Upper Peninsula. Table 19 shows the effect size index results of the relationship between region one and region two snowmobile recreational specialization and their spatial interaction.

Table 19 Relationship between Region One and Two Specialization and Spatial Interaction

Residential Region	Destination Region	η	η^2
Region 1	Region 1	.174	.03
(western Upper Peninsula)	Region 2	.134	.01
Region 2	Region 1	.121	.01
(eastern Upper Peninsula)	Region 2	.311	.10

For snowmobilers lived in region three, Kruskal-Wallis results showed that there were statistically significant differences on spatial interaction among specialization subgroups when they travel to region two (χ^2 (2) = 10.718, p = .005) and region four (χ^2 (2) = 9.060, p = .011) for snowmobiling. For region three snowmobilers who went to region two to snowmobile, *post-hoc* analysis showed that there were statistically significant differences between expert snowmobilers and novice snowmobilers (p = .033), and expert and intermediate snowmobilers (p = .007). Since the spatial interaction results were highly skewed and not normally distributed, the mean rank

scores were utilized instead of mean score to report the strength of spatial interaction. The SPSS program did not generate the mean rank scores for those destination regions with no significant differences among specialization subgroups. A higher ranking score indicates a stronger spatial interaction between origin and destination.

Table 20 Spatial Interaction between Region Three Snowmobilers and Trail Network

Residential Region	Destination Region	Recreational Specialization	Mean Rank	Median	Sum	S.D.
Region 3 (northwestern Lower Peninsula)	Region 1	Novice	N/A	.0	6.1	.9
		Intermediate	N/A	.0	2.9	.4
		Expert	N/A	.0	6.8	.6
	Region 2*	Novice	37.56	.0	114.8	12.5
		Intermediate	35.54	.0	45.9	6.8
		Expert	50.66	.7	158.4	8.6
	Region 3	Novice	N/A	122.5	4687.0	231.2
		Intermediate	N/A	45.7	10654.8	1572.0
		Expert	N/A	22.8	4715.2	381.2
	Region 4*	Novice	37.00	.0	.0	.0
		Intermediate	47.25	.0	84.8	7.8
		Expert	39.83	.0	19.1	3.0
	Region 5	Novice	N/A	.0	.0	.0
		Intermediate	N/A	.0	.0	.1
		Expert	N/A	.0	.0	.0

** = Significant at the .05 level*

Results showed that expert snowmobilers had significantly higher spatial interaction compared to novice and intermediate snowmobilers. No apparent spatial interaction difference was found between intermediate and novice snowmobilers. For region three snowmobilers who went to region four to snowmobile, *post-hoc* analysis showed that there was a statistically significant difference between novice and intermediate snowmobilers (p = .012). The mean rank scores showed that intermediate snowmobilers from region three had the highest spatial interaction with the trail system in region four compared to novice and expert snowmobilers. No statistically significant differences were found among other groups. Table 20 presents the

descriptive result for spatial interaction among three specialization subgroups from region three and snowmobile trail networks by five regions.

Additionally, the effect size index Eta results showed that there were weak relationships between region three snowmobilers' recreational specialization and their spatial interaction with regions two, three, and five. A moderate relationship was found between recreational specialization and spatial interaction with region four. Eta squared showed that less than 7% of the spatial interaction variance was explained by recreational specialization. Table 21 presents the comparison result of spatial interaction between region three specialization subgroups and the five destination regions.

Table 21 Comparison Result of Spatial Interaction for Region Three Specialization Subgroups

	Region 3 Specialization Subgroups					
Destination Region	Novice	Intermediate	Expert	χ^2 (*sig.*)	η	η^2
Spatial Interaction with Region 1				2.090	.098	.01
Spatial Interaction with Region 2	a	b	ab	10.718*	.176	.03
Spatial Interaction with Region 3				3.945	.104	.01
Spatial Interaction with Region 4	a	a		9.060*	.260	.07
Spatial Interaction with Region 5				1.929	.154	.02

a,b,ab Groups with a same letter were significantly different at the .05 level of confidence
** = Significant at the .05 level*

For snowmobilers who resided in region four, Kruskal-Wallis results showed that there were statistically significant differences on spatial interaction among recreational specialization subgroups when they travel to region one (χ^2 (2) = 9.638, p = .008) and region four (χ^2 (2) = 7.065, p = .029). For region four snowmobilers who went to region one to snowmobile, *post-hoc* analysis showed that there were statistically significant differences between expert snowmobilers and novice snowmobilers (p = .025), and expert and intermediate snowmobilers (p = .021). Since the spatial interaction results were highly skewed and not normally distributed, the mean rank scores were utilized instead of mean score to report the strength of spatial interaction. The SPSS

program did not generate the mean rank scores for those destination regions with no significant differences among specialization subgroups. A higher ranking score indicates a stronger spatial interaction between origin and destination. Table 22 presents the descriptive statistics for spatial interaction between three specialization subgroups from region four and snowmobile trail networks by five regions.

Table 22 Spatial Interaction between Region Four Snowmobilers and Trail Network

Residential Region	Destination Region	Recreational Specialization	Mean Rank	Median	Sum	S.D.
Region 4 (Northeastern Lower Peninsula)	Region 1*	Novice	43.50	.0	.0	.0
		Intermediate	43.50	.0	.0	.0
		Expert	50.61	.0	3.3	.3
	Region 2	Novice	N/A	.0	33.1	3.7
		Intermediate	N/A	.0	59.9	5.6
		Expert	N/A	.0	98.1	5.8
	Region 3	Novice	N/A	.0	302.4	17.1
		Intermediate	N/A	.0	197.8	11.7
		Expert	N/A	.0	132.7	8.9
	Region 4*	Novice	35.09	32.8	3182.0	296.3
		Intermediate	52.05	71.5	1113.7	173.4
		Expert	49.69	68.3	56956.4	9223.8
	Region 5	Novice	N/A	.0	.0	.0
		Intermediate	N/A	.0	.0	.0
		Expert	N/A	.0	.0	.0

** = Significant at the .05 level*

The mean rank scores showed that expert snowmobilers had significantly higher spatial interaction than either novice or intermediate snowmobilers when traveling to region one to snowmobile. For region four snowmobilers riding in their own residential region, *post-hoc* analysis showed that there was a statistically significant difference between novice and intermediate snowmobilers ($p = .041$). Intermediate snowmobilers had significantly higher spatial interaction than novice snowmobilers when snowmobiling in region four. No other statistically significant differences were found among other groups.

The effect size index Eta result showed that there were weak relationships between region four snowmobilers' recreational specialization and their spatial interaction with region two, three, and four. A moderate relationship was found between recreational specialization and spatial interaction with region one. Eta squared showed that less than 9% of the spatial interaction variance was explained by recreational specialization. Table 23 presents the comparison result of spatial interaction between region four specialization subgroups and five destination regions.

Table 23 Comparison Result of Spatial Interaction for Region Four Specialization Subgroups

	Region 4 Specialization Subgroups					
Destination Region	Novice	Intermediate	Expert	χ^2 (*sig.*)	η	η^2
Spatial Interaction with Region 1	a	b	ab	9.638*	.302	.09
Spatial Interaction with Region 2				5.700	.150	.02
Spatial Interaction with Region 3				1.087	.211	.04
Spatial Interaction with Region 4	a	a		7.065*	.145	.02
Spatial Interaction with Region 5				< 0.0005	-	-

a,b,ab Groups with a same letter were significantly different at the .05 level of confidence
** = Significant at the .05 level*

For snowmobilers resided in region five, Kruskal-Wallis result showed that there were statistically significant differences on spatial interaction among recreational specialization subgroups when they travel to region one (χ^2 (2) = 15.363, $p < .0005$) and region two (χ^2 (2) = 22.751, $p < .0005$) for snowmobiling. For region five snowmobilers who went to region one for snowmobiling, *post-hoc* analysis showed that there were statistically significant differences between expert and novice ($p = .001$), and expert and intermediate snowmobilers ($p = .010$). For region four snowmobilers who went to region one for snowmobiling, *post-hoc* analysis showed that there were statistically significant differences between expert and novice ($p = .025$), and expert and intermediate snowmobilers ($p = .021$). Since the spatial interaction results were highly skewed and not normally distributed, the mean rank scores were utilized instead of mean score to

report the strength of spatial interaction. The SPSS program did not generate the mean rank scores for those destination regions with no significant differences among specialization subgroups. A higher ranking score indicates a stronger spatial interaction between origin and destination. Table 24 presents the descriptive statistics for spatial interaction between three specialization subgroups from region four and snowmobile trail networks by five regions.

Table 24 Spatial Interaction between Region Five Snowmobilers and Trail Network

Residential Region	Destination Region	Recreational Specialization	Mean Rank	Median	Sum	S.D.
Region 5 (Northeastern Lower Peninsula)	Region 1*	Novice	270.21	.0	23.3	.4
		Intermediate	279.20	.0	18.5	.3
		Expert	312.42	.0	27.2	.3
	Region 2*	Novice	263.28	.0	18.5	.3
		Intermediate	270.52	.0	133.9	1.3
		Expert	328.53	.5	208.7	1.6
	Region 3	Novice	N/A	1.2	1215.9	14.3
		Intermediate	N/A	2.8	1527.4	20.4
		Expert	N/A	2.1	1616.7	17.6
	Region 4	Novice	N/A	.0	510.8	5.6
		Intermediate	N/A	.0	522.4	5.1
		Expert	N/A	.0	358.0	3.3
	Region 5	Novice	N/A	.0	2423.2	80.3
		Intermediate	N/A	.0	2736.9	90.3
		Expert	N/A	.0	1551.4	33.9

** = Significant at the .05 level*

The mean rank scores indicated that expert snowmobilers had statistically significantly higher spatial interaction than either intermediate or novice snowmobilers when traveling to region one for snowmobiling. For region five snowmobilers who went to region two for snowmobiling, *post-hoc* analysis also showed that there were statistically significant differences between expert and novice ($p < .0005$), and expert and intermediate snowmobilers ($p < .0005$). The mean rank scores indicated that the expert snowmobilers had statistically significantly higher spatial interaction than either intermediate or novice snowmobilers when traveling to region two for snowmobiling.

The effect size index Eta result showed that there were weak relationships between region five snowmobilers' recreational specialization and their spatial interaction with region two. Eta squared showed that less than 1% of the spatial interaction variance was explained by recreational specialization. Table 25 presents the comparison result of spatial interaction between region four specialization subgroups and five destination regions.

Table 25 Comparison Result of Spatial Interaction for Region Five Specialization Subgroups

	Region 5 Specialization Subgroups					
Destination Region	Novice	Intermediate	Expert	χ^2 (*sig.*)	η	η^2
Spatial Interaction with Region 1	a	b	ab	15.363*	.057	> .00
Spatial Interaction with Region 2	a	b	ab	22.751*	.114	.01
Spatial Interaction with Region 3				4.034	.057	> .00
Spatial Interaction with Region 4				1.467	.075	.01
Spatial Interaction with Region 5				.302	.034	> .00

a,b,ab Groups with a same letter were significantly different at the .05 level of confidence
** = Significant at the .05 level*

Section Summary

According to the results of the Kruskal-Wallis and effect size Eta tests, evidence of statistical differences in spatial interaction was found across levels of recreational specialization. Therefore, the research rejected null hypothesis 11 and concluded that there were some minimal to moderate relationships between different levels of specialization and snowmobilers' spatial interaction with the snowmobile trail network.

Statistically significant differences were found across novice, intermediate, and expert snowmobilers on the spatial interaction between all Michigan snowmobilers and the snowmobile trail network in regions one, two, and four. When segmenting snowmobilers by their residential regions, statistically significant differences among levels of specialization were found on spatial interaction between region three snowmobilers and the snowmobile trail network in region two and four; region four snowmobilers and the snowmobile trail in regions one and four; and region

five snowmobilers and the snowmobile trail in regions one and two. The relationship between specialized snowmobilers from different regions and their spatial interaction with the snowmobile trail network, indicated by Eta, ranged from 0.034 to 0.311, showing a minimal relationship to a moderate relationship (0.10 – 0.242 = weak relationship; 0.243 – 0.370 = moderate relationship; 0.371 or greater = strong relationships).

When segmenting snowmobilers by their residential regions, no spatial interaction was found between the Upper and Lower Peninsulas for those who lived in the Upper Peninsula. However, moderate relationships were found for region two snowmobilers riding sleds in their own region; region three snowmobilers riding in region four; and region four snowmobilers traveling to region one. Levels of recreational specialization explained at least 7% of the variance of spatial interaction. Weak relationships were found among various travel patterns, for instance, when region five snowmobilers traveled to region two and when region four snowmobilers traveled to region three for snowmobiling. In summary, levels of recreational specialization explained 1% to 4% of the variance of spatial interaction, making for a minimal meaningful difference.

Chapter Five

Discussion, Implications, and Conclusions

Research Background

Snowmobiling is a winter recreation activity that contributes substantially to Michigan's economy through travel and equipment expenditures by snowmobilers. Snowmobiles, originally developed for over-snow transportation purposes, are now used by snowmobilers mostly for enjoyment, including the thrill of high speed travel over the snow. This research explores the within-group social world of Michigan snowmobilers using the well-established theoretical framework of recreational specialization, as well as two topics of interest associated with snowmobiling. The first is snowmobile fatalities. Law enforcement and recreation program managers seek to provide a safe riding environment and quality recreation experiences for all snowmobiling participants. To help reduce the incidence and severity of snowmobile accidents, snowmobilers' perceptions of key riding risks were assessed and potential links with recreational specialization were examined, in the hopes of discovering recognizable patterns among segments to best target safe riding education and training intervention programs, as well as law enforcement management actions. Secondly, for the recreational specialization construct, the research explored the determinants that facilitate or constrain the advancement of recreational specialization in terms of the spatial construct of resource availability and accessibility. This included the proximity and quantity of the recreation resource, both in terms of trail mileage and quantity of snow. In sum, the objectives of this research were to describe and compare different levels of recreational specialization among Michigan snowmobilers; examine the influence of recreational specialization on snowmobilers' perception of riding risks; and assess the

relationships between snowmobilers' recreational specialization and spatial interaction with the Michigan snowmobile trail network.

Discussion

Three research objectives are addressed and discussed in this section: Michigan snowmobilers' within-group social world, the influence of recreational specialization on perceptions of risk, and the relationships between recreational specialization and snowmobilers' spatial interaction with the Michigan snowmobile trail network.

Table 26 provides a summary of the tests and outcomes for 11 research hypotheses. This research found a significant difference in group composition between levels of specialization using summative indices and cluster analysis. Further, the only significant differences among snowmobiler subgroups in terms of risk perception were found on perceptions of "Speed of snowmobile" and "Cars/trucks on seasonal roads." Recreational specialization not appeared to be an effective construct in predicting snowmobilers' perception of risks. Lastly, Michigan snowmobilers' spatial interaction with the snowmobile trail system showed that different levels of specialized snowmobilers had their preferred destinations. There is a weak to moderate statistically significant relationship between recreational specialization and spatial interaction with Michigan snowmobile trail system.

Table 26 Research Hypotheses, Tests, and Outcome

Null Hypotheses	Tests	Outcome
H_1: There is no difference in group composition between levels of specialization using summative indices and cluster analysis.	ANOVA	Rejected
H_2: There is no relationship between snowmobilers' recreational specialization and their perception of operating a snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol).	MANOVA ANOVA Effect Size Eta (η)	Failed to reject
H_3: There is no relationship between snowmobilers 'recreational specialization and their perception of operating a snowmobile by a legally intoxicated person (0.08 or higher blood alcohol).	MANOVA ANOVA Effect Size Eta (η)	Failed to reject
H_4: There is no relationship between snowmobilers 'recreational specialization and their perception of speed of snowmobile.	MANOVA ANOVA Effect Size Eta (η)	
H_5: There is no relationship between snowmobilers 'recreational specialization and their perception of driver lacking skill in operating machine.	MANOVA ANOVA Effect Size Eta (η)	Failed to reject
H_6: There is no relationship between snowmobilers 'recreational specialization and their perception of cars/trucks on seasonal roads.	MANOVA ANOVA Effect Size Eta (η)	Rejected
H_7: There is no relationship between snowmobilers 'recreational specialization and their perception of public trail conditions.	MANOVA ANOVA Effect Size Eta (η)	Failed to reject
H_8: There is no relationship between snowmobilers 'recreational specialization and their perception of public trail design.	MANOVA ANOVA Effect Size Eta (η)	Failed to reject
H_9: There is no relationship between snowmobilers 'recreational specialization and their perception of other uses of designated snowmobile trails (e.g., dog sledding, cross country skiing).	MANOVA ANOVA Effect Size Eta (η)	Failed to reject
H_{10}: There is no relationship between snowmobilers 'recreational specialization and their perception of snowmobiling on county/state road shoulders.	MANOVA ANOVA Effect Size Eta (η)	Failed to reject
H_{11}: There is no relationship between levels of recreational specialization and snowmobilers' spatial interaction with the snowmobile trail network.	Kruskal-Wallis Effect Size Eta (η)	Rejected

Michigan Snowmobilers' Within-group Social World

The theoretical construct of recreational specialization was applied to study the within-group social world of Michigan snowmobilers. Two common classification approaches, summative index and cluster analysis, were utilized to identify different levels of specialization in snowmobilers. Consistent with previous studies on anglers (Oh & Ditton, 2006), skiers and snowboarders (Needham & Little, 2013), off-highway vehicle (OHV) riders (Smith, Burr, & Reiter, 2010), and many other outdoor recreationalists, different levels of recreational specialization were successfully identified with snowmobilers. The summative index method generated three snowmobile subgroups, novice, intermediate, and expert, while cluster analysis provided three different levels of specialization: moderate, big spender, and trail warrior. Through the analysis, this research showed that Michigan snowmobilers are heterogeneous differing in their levels of recreational specialization. More specifically, they differ in their behavioral commitment, knowledge/skill about snowmobiling, and psychological attachment to snowmobile clubs or organizations.

Unlike many studies, which only used either the summative index or cluster analysis approach to segment recreationalists without clear justification (e.g., Donnelly et al., 1986; Dyck et al., 2013; Needham et al., 2007), this research adds to the literature on recreational specialization by comparing the composition and characteristics of subgroups identified by both methods. This meets one of the goals of this research. In contrast to the only published research that compared both methods and found no difference between them in terms of results (Scott et al., 2005), this research suggested that the summative index method and K-mean cluster analysis provide dissimilar perspectives of snowmobilers' within-group social worlds.

Using the summative index method, three subgroups – novice, intermediate, and expert – formed a continuum "from general to particular" that was consistent with what Bryan originally hypothesized (Bryan, 1977, p. 175). In contrast to Tennessee River users (Kuentzel & McDonald, 1992) and rock climbers (Ewert & Hollenhorst, 1994), all six variables used to measure snowmobilers' recreational specialization appeared to increase in the same direction as the level of specialization increased. Expert snowmobilers presented more intensive behavioral commitment (snowmobiles owned, money spent, and snowmobiling experience), knowledge/skill (snowmobile days and mileage), and psychological attachment (snowmobile organization membership) to the activity when compared to intermediate and novice snowmobilers. Intermediate snowmobilers also showed significantly deeper involvement in the activity compared to novices. The progression of recreational specialization is evident as commitment and involvement in the activity increased.

Using an alternative K-mean cluster analysis approach, three subgroups, moderates (65%), big spenders (11%), and trail warriors (24%), were identified. Although there were statistically significant differences among three subgroups on behavior, skill/knowledge, and psychological attachment characteristics, disparities between big spender and trail warrior snowmobilers were less apparent compared to the differences between moderate and both big spender and trail warrior snowmobilers. Big spenders had a much greater economic commitment than other groups, while trail warriors rode more days traveling more miles. Similar to the group composition results in studies of birders (McFarlane, 1996; Scott & Thigpen, 2003), the majority (77%) of Michigan snowmobilers casually participated in the activity and presented relatively weak behavioral commitment, skill/knowledge, and psychological attachment to a snowmobiling club or organization. Two relatively more specialized subgroups, big spenders and trail warriors,

had not necessarily progressed along the specialization continuum. Rather they were so named because they displayed their own particular interests. In a further review of the data, 94% of the big spenders purchased a snowmobile in the snowmobile season 2007-08. This brought up the question that those big spenders may have been the trail warriors who simply purchased a snowmobile in the past 12 months. However, the results also showed that big spenders and trail warriors were not only significantly different in money spent ($10,398 vs. $1,504), but also snowmobile days (27 vs. 37) and miles driven (2058 vs. 3048) in 2007-08 winter. A very similar result was found in a study of birders in Thailand (Hvenegaard, 2002). There the more specialized birders were further divided into two subgroups and the two advanced subgroups significantly differed in their economic commitment. These finding are similar to other studies (McIntyre & Pigram, 1992; Scott & Thigpen, 2003) that suggested recreationalists may place their priority on one aspect of specialization over another. The trajectories and progression within each of the dimensions are not necessarily identical and may increase or decrease in different directions (Needham et al., 2007). Similar comments were addressed by Scott and Shafer (2001) that some recreationists "continue to participate in activities on a regular basis and accrue commitments but exhibit little evidence of skill development… other individuals may participate in leisure activities infrequently but demonstrate a high level of skill development and personal commitment" (p. 338). The cluster analysis result, different from that found using the summative method, supported the above studies in that a portion of Michigan snowmobilers cannot be placed neatly along a continuum from low to high. Big spenders and trail warriors did not necessarily progress along the continuum in the linear fashion on all six specialization variables as they displayed distinct specialization characteristics on behavioral involvement in and skill/knowledge of snowmobiling.

The summative index method and K-mean cluster analysis are two commonly used but fundamentally and mathematically different approaches for categorizing recreationalists. The subgroups generated from the summative index approach were selected to assess the influence of recreational specialization on snowmobilers' perceptions of riding risks and their spatial interaction with the snowmobile trail network for the following reasons. First, novice, intermediate, and expert snowmobilers formed a specialization continuum from low to high which fit the original hypothesis of Bryan (1977). The linear relationships between concepts can be better explained when the independent variable presented a hierarchical status in terms of snowmobile participation. Second, the summative index approach generated much more distinct subgroups compared to the cluster analysis. All six measures of specialization were significantly different among the subgroups identified by the summative index approach. The between group differences among the cluster analysis subgroups were less apparent, especially between the two advanced subgroups, big spenders and trail warriors. This research did not select the recreationalist classification method arbitrarily. The decision was made based on the comparison of two commonly used methods - summative index and cluster analysis as well as the purposes of the study.

It is important to note that the classification method and the six measures of recreational specialization may potentially constrain the representation of Michigan snowmobilers' within-group social world. Both summative index and cluster analysis methods are straightforward and easily employed, however, there are other less commonly used methods of measuring recreational specialization and its effect on other behavioral or cognitive constructs. While a considerable literature suggests that recreational specialization is a multi-dimension measurement with behavioral, knowledge/skill, and psychological attachment variables, it also

notes that self-rated skill level and centrality-to-life were suggested to be the more reliable indicators of recreational specialization (McFarlane, 2004; McIntyre & Pigram, 1992; Smith et al., 2010). A simplified, self-classification measure with descriptive statements that reflect specialization features was also suggested to provide a valid grouping result (Scott et al., 2005). More sophisticated analysis procedures such as confirmatory factor analysis, structural equation modeling and discriminant analysis were also suggested to provide meaningful results (Jett et al., 2009; Lee & Scott, 2004; Needham et al., 2007; Oh et al., 2012). Since this research utilized a data set that was originally designed to obtain information on behavioral involvement in snowmobiling and economic impact of snowmobile spending, using different measures or indicators of behavioral, knowledge/skill, and psychological attachment variables in the future could provide a richer picture of other aspects of Michigan snowmobilers' within-group social world.

Influence of Specialization on the Perception of Risk

Transportation and accident research shows evidence of a strong relationship between drivers' personality and perception of risks. Since no known published research studied perception of risk utilizing the recreational specialization construct, this research turned to literatures that studied the influence of recreational specialization on recreationalist' attitudinal change. Unlike previous studies which showed that increasing recreational specialization predicts perceived flow experiences and generally supported the positive association of recreational specialization with recreationists' attitudes toward environmental restrictions and resource protection policies (Dyck et al., 2003; Oh & Ditton, 2006; Wöran & Arnberger, 2012), this research found recreational specialization did not effectively predict snowmobilers' perception of riding risks. The only statistically significant differences among snowmobiler

subgroups were found on perceptions of “Speed of snowmobile” and “Cars/trucks on seasonal roads,” but with weak relationships between recreational specialization and perception of risk. A similar result was found in a boater study in “Manatee Zones” in Florida, where recreational specialization performed poorly in predicting self-reported compliance behavior and restricted vessel speed (Jett et al., 2009). Possible explanations regarding the weak association between specialization and perception of risk in this study may be related to how participants interpreted the risks of different hazardous riding scenarios. While the dangers of driving drunk are well known, information about almost half of snowmobile fatalities occurring on county roads and state highways may not be well known across the snowmobiling community (Nelson et al. 1998). It is also possible that snowmobilers rated their responses to the various underlying components of risk in a relatively neutral fashion. Given a five-point Likert scale for measuring perceptions, Bertram (2007) indicated that participants may avoid selecting an extreme value or provide a more socially acceptable answer rather than being honest.

Despite the weak association, the research found two statistically significant differences among snowmobiler subgroups on the perceptions of “Speed of snowmobile” and “Cars/trucks on seasonal roads.” For the purpose of identifying those who tend to underestimate snowmobiling risks, this research found that expert snowmobilers tended to underestimate the risk of speeding, while novice snowmobilers perceived low risk of cars/trucks on seasonal roads.

Speeding has been one of the key factors directly associated with Michigan snowmobile fatalities (Michigan DNR, 2008; 2009; 2010; 2011; 2012; 2013). It is reasonable to assume that snowmobilers who underestimate this relationship tend to engage in risky, high speed behavior. Those who were categorized as expert snowmobilers perceived significantly less risk from speeding compared to novice snowmobilers. Confidence in operating and controlling a

snowmobile may result in a reduced perception of risk from speeding. This finding is consistent with Morgan and Stevens' (2008) study on SCUBA divers, in that perceived risk decreased significantly as experience increased. A study on mountaineers' perception of risk showed similar results in that individuals with the most experience perceived the lowest level of risk (Demirhan, 2005). Although his research did not examine the relationship between recreational specialization and risky riding behaviors, Lynch's (2000) study on convicted Michigan snowmobile law violators found those who were convicted of violating snowmobile laws owned a higher number of snowmobiles, rode more days traveling more miles and perceived speeding as less dangerous compared to those who were not convicted of violating snowmobile laws.

This finding is different than vehicular traffic research, which suggests that young and inexperienced drivers (typically teenagers) tend to underestimate the potential risk of excessive speeding (Deery, 1999; Machin & Sankey, 2008). Studies of snowmobile fatalities in the United States and Scandinavia concluded that young males in their thirties were the predominate victims of snowmobile accidents (Öström & Eriksson, 2002; Rowe et al., 1992; Stewart & Black, 2004). This difference may be explained by the different age distribution between licensed drivers and Michigan snowmobilers. While licensed drivers were relatively evenly distributed across age 20 to 65 (National Safety Council, 2014), 70% of the Michigan snowmobilers were between the age of 35 to 60, with mean age of mid-40s (Nelson et al., 2009). It is also likely that individuals operated a snowmobile as a sensation-seeking recreational activity, rather than one with a clear transportation component that characterizes vehicular travel on roads. Therefore, recreationists may be more likely to neglect rules for snowmobile operation and underestimate potential risks from thrill seeking behaviors such as excessive speed and operation on roads where conditions often favor reaching high speeds.

Those categorized as novice snowmobilers were found to perceive significantly less danger from "Cars/trucks on seasonal roads" compared to intermediate and expert snowmobilers. Michigan snowmobile fatality accident data shows that 10% of the snowmobile fatalities from 2008-13 resulted from snowmobilers colliding with cars or trucks (Michigan DNR, 2008; 2009; 2010; 2011; 2012; 2013). The finding is different from Lynch's (2000) study, which found that those who snowmobiled more days and miles perceived cars/trucks on seasonal roads as less dangerous than those who did not violate snowmobile laws. That novice snowmobilers in the current study perceived significantly lower risk from cars or trucks on seasonal roads may due to a lack of experience and awareness. The results from this research indicate that once a novice's riding days and miles increase, they become marginally more aware of the threats posed by vehicles on the seasonal roads often used for snowmobiling.

Although less apparent, the influence of recreational specialization on other perceptions of riding risk varied in direction. Recreational specialization seemed to positively affect perception of risks when intermediate and expert snowmobilers perceived higher risks on "Operation of snowmobile by person who has been drinking but is not legally intoxicated" and "Driver lacking skill in operating machine," when compared to novice snowmobilers. Recreational specialization appeared to negatively affect perception of risks when novice and intermediate perceived higher risk on "Public trail condition" and "Public trails design" compared to expert snowmobilers. Although this finding is consistent with the previous Michigan snowmobile study that found snowmobiler subgroups differed in their perception of risks (Lynch, 2000), intensified enforcement efforts on both the designated trail system and Michigan road shoulders initiated in the late 90s could have changed Michigan snowmobiling dynamics. As shown in two recent Michigan snowmobiling reports (Nelson et al., 1998; Nelson

et al., 2009), the reported percentage of snowmobilers seeing law enforcement personnel while on their snowmobile or being contacted by a law enforcement official while snowmobiling has increased 10%. This may be linked to the decline in snowmobile fatalities, which have fallen from an average of 36 annually in the early 1990s to 20 fatalities annually in the past 10 years. The presence of law enforcement may also have a positive influence on reducing risky snowmobiling behavior, even as machines have gotten faster and the trail system has expanded. While increases in snowmobile speed, handling and comfort have made it easier to ride longer and faster, the increased visible presence of officers may be providing an effective deterrent to illegal or risky behaviors. This still suggests that further improvements in safety and perception of risk can be made and it is likely that snowmobile program managers and policy makers will need to specifically develop intervention programs, regulations or even greater enforcement presence to better prevent snowmobile accidents.

It is worthy of note that novice, intermediate, and expert snowmobilers saw evenly minimal risk on "snowmobiling on county/state road shoulders," while 43% of snowmobiling fatalities occurred on county/state or seasonal roads (Michigan DNR, 2008; 2009; 2010; 2011; 2012; 2013) and during the early 1990s, 48% occurred in those same situations (Nelson et al. 1998). With this continued clear risk of riding on county/state road shoulders, it is important to develop strategies to reduce fatalities in these locations as described in the administrative recommendation section. In summary, based on the lack of distinction along the continuum of recreational specialization in relationship to perception of risk, massages, programs, regulations and enforcement would appear to be effective if targeted to snowmobilers as a while without tailoring efforts to certain segments of the population. This is borne out by the significant

reduction in snowmobiling fatalities since more aggressive and visible enforcement efforts were initiated across the snowmobiling population following the Nelson et al. (1998) study.

Relationships between Recreational Specialization and Spatial Interaction

The results of the effect size Eta showed a weak relationship between Michigan snowmobilers' recreational specialization and their spatial interaction with snowmobiler trail network. However, a spatial interaction difference was found among novice, intermediate, and expert snowmobilers. For Michigan snowmobilers, the destination trail networks in regions one (western UP), two (eastern UP), and four (northeastern LP) appeared to attract different levels of specialization among snowmobilers. Expert snowmobilers from region four and five (southern LP) had a significantly stronger spatial interaction with region one compared to less specialized snowmobilers. Similar attractiveness was found for region two as expert snowmobilers from region three (northwestern LP) and region five particularly went to the region for snowmobiling. Interestingly, region four specifically attracted intermediate snowmobilers from region three and four; they had significantly stronger spatial interaction with the snowmobile trail network in region four compared to expert and novice snowmobilers.

The above results are closely in line with the studies of recreationalists' site preferences as different levels of specialization differ in setting preferences and site choices. Bryan (1977) hypothesized that highly specialized individuals seek settings to test their skill and exert control. While this aspect would need future investigation with snowmobilers, research concerning skiers and snowboarders' consumption behaviors confirmed that those with higher skill/knowledge preferred a variety of new and challenging downhill opportunities and that snow condition became more important as the frequency of skiing and snowboarding increased (Won et al., 2008). McFarlane's (2004) vehicle-based camper study also concluded that

specialized campers seek settings that require a higher degree of self-reliance. It is likely that snowmobile trails in the Upper Peninsula have special meaning to expert snowmobilers. The scenery along the trail, quantity and quality of available trail loops, trail grooming quality, remoteness, and lodges and restaurants available could all be contributing factors. More specifically, the predictive mechanism of spatial interaction could benefit from a close examination of place attachment and recreational specialization, as Oh and his colleagues (2012) suggest in their study of anglers' skill levels and their emotional attachment to a recreational place. Those with high commitment tend to develop functional meanings and emotional attachment to their favorite sites.

This study showed the spatial availability and accessibility of the snowmobile trail network in regions one, two, and four are likely to explain the variation between snowmobilers. There were 1,819 miles of snowmobile trail in region one with 136.9 inches of snowfall in winter 2007-08, which produced the best spatial availability among Michigan regions. The significant snowmobiling opportunity attracted expert snowmobilers from region four and five who were willing to travel a long distance for the winter activity. Region four snowmobilers on average traveled 312 miles while region five snowmobilers on average traveled 445 miles in order to access to region one for snowmobiling. This result confirmed Bryan's (1977) assumption that more specialized recreationalists are willing to travel farther in order to access what they consider exceptional opportunity, compared to their less specialized counterparts. Similarly, the snowmobiling opportunity in region two had 1,371 miles of snowmobile trail with 138.4 inches of snowfall in winter 2007-08, providing the second best environment for snowmobilers, particularly expert snowmobilers from regions three and five. The mean travel distance from regions three and five to region two were 123 miles and 252 miles respectively. Region four, on

the other hand, was the favorite destination for intermediate snowmobilers from region three and four. The 1,194 miles of trail and 83.7 inches of snowfall in the region attracted snowmobilers on average traveling only 73.6 miles and 36.8 miles, respectively, for snowmobiling. As the literature states, accessibility to recreational opportunity can be one of the major constraints for regional skiers and snowboarders. Less specialized skiers and snowboarders tend to be more concerned about cost barriers than those who are more advanced (Won et al., 2008). Novice snowmobilers presented similar characteristics in this research as they were likely to travel shorter distances to snowmobile than expert snowmobilers.

The study found no evidence of spatial interaction between Upper and Lower Peninsula for those who lived in Upper Peninsula. This suggests that those snowmobilers who resided proximate to relatively better snowmobile opportunity in the Upper Peninsula did not travel south across the Mackinac Bridge to access comparatively less miles of snowmobile trail and less snowfall in Lower Peninsula of Michigan. It is unlikely that they would access other adjacent states such as Minnesota and Wisconsin, where while there is a substantial trail network, snowfall/snow cover is less dependable.

The gravity model applied in this research provided a useful approach to measuring spatial interaction between snowmobilers and recreation opportunity using the destination attributes of winter snowfall, snowmobile trail mileage, and Euclidean travel distance as a friction function. The percentage of visitation in each managerial region was also incorporated to account for the attractiveness of the destination. Baxter (1979) argued that the attractiveness of trip destinations should be specified exogenously instead of being constant. However, the debates on appropriate calibration, algebraic forms between parameters, and friction exponential as raised by Sen and Smith (1995) are not likely to end with this current study. Nevertheless, the

model used in this study does provide meaningful measures and a partial explanation of spatial interaction, furthering understanding of the relationship between the spatial structures of snowmobile trails and users' specialization. The findings in this snowmobiling study confirmed findings regarding Oklahoma state parks using the gravity model. Fesenmaier and Lieber (1985) found that the spatial distribution of state parks and their recreation facilities had a substantial effect on visitation at one park over another. Future research is certainly warranted to further improve functioning and accuracy of the gravity model.

Managerial Implications and Recommendations

General Managerial Implications

Three key managerial implications were revealed by this research. First, the results from both summative index and cluster analysis demonstrated that Michigan snowmobilers are a heterogeneous group with unique behavior, skill/knowledge, and psychological attachment characteristics. Some of them progressed through a linear trajectory such that they became more specialized when they spent more time and money on the activity. Others focused on different aspects of snowmobiling such as trail riding or conspicuous consumption, once they acquired enough snowmobiling experience, without advancing on a linear path of specialization.

Second, overall perceptions of risky snowmobile riding behaviors were not well predicted by level of recreational specialization. Universally and most critically, snowmobilers of all levels of specialization perceived relatively little risk form the riskiest place to ride a snowmobile, a state or county road shoulder. However, the dangers of operating a snowmobile while intoxicated were known across the continuum of specialization. Further research could perhaps most profitably focus on the influence of the increased visible presence of officers as actual fatalities have fallen in Michigan since such additional enforcement efforts have been put in place.

Finally, different regions of the Michigan snowmobile trail system appeared to attract different levels of specialization in Michigan snowmobilers. Expert snowmobilers, who resided in the Lower Peninsula, preferred snowmobile trails in the Upper Peninsula, with its extensive trail mileage and snowfall. Intermediate snowmobilers favored snowmobile trails in northern Lower Peninsula, which provided somewhat less snowmobiling opportunity due to less snowfall, but facilitated snowmobiling with less commitment as drive time/distance to trails was reduced. Additional snowmobile trail development in the northern Lower Peninsula appears more likely to provide a larger economic return in regards to Michigan residents considering the proximity to Michigan's population centers.

Administrative Recommendations

Several administrative recommendations regarding Michigan snowmobilers and their perception of risks of and spatial interaction with the snowmobile trail network are presented in this section. Program directors and managers may be more informed in terms of diverse characteristics displayed by Michigan snowmobilers and how this profile can aid in the execution of marketing strategies and management actions.

A mandatory snowmobile training course for all first time Michigan snowmobile trail permit purchasers for those born on or after January 1st of 1998

The current snowmobile education program targets snowmobilers 16 years or younger, however, with the aging baby boomers and the incoming tourist searching for experience, individuals may start snowmobiling at a later stage of the life. A mandatory education or training only for those under 16 neglects those novice snowmobilers. Therefore, for those first time Michigan snowmobile trail permit purchasers born on or after January 1st of 1998 (17 years or

younger), should take and pass a mandatory snowmobile training course. If this birth year is held constant, annually this will increasingly involve new snowmobilers of more ages, just as has been done with hunter safety education in Michigan and many other states (Michigan DNR, 2014). Because this has happened gradually with hunter safety, there has been minimal complaint and hunting fatalities related to firearm and archery safety have declined by more than half in Michigan since this hunter safety education requirement was implemented coupled with the requirement to wear hunter orange when hunting in most situations.

Education should be focused on riding behaviors that are critical in safeguarding snowmobilers as well as snowmobile rules and laws. The training program should help not only raise awareness of several key riding risks underestimated by snowmobilers (i.e., drivers lacking skill in operating machine; snowmobile on county/state road shoulders), but also familiarize all snowmobilers with important operating skills and threats posted by other snowmobilers or other users of the snowmobile trail system. As a result, the incidence and severity of snowmobile accidents can be reduced by properly designed training and education.

Disseminate snowmobile regulations, riding tips, the consequence of violating regulations, and fatality details to identified target segments of snowmobilers in key snowmobile information nodes such as snowmobile rental outlets, Secretary of State Offices, and snowmobile dealers, as well as on the DNR website

While Michigan snowmobilers are not a homogeneous group, the minimal variation of perceived risk on nine hazardous snowmobile riding behaviors disclosed by this research demonstrates that there is little need to craft detailed strategies for less than the full population of snowmobilers regarding appropriate assessment of risk. Relevant information such as booklets,

brochures, accident details, and safe riding guides should be widely distributed particularly to snowmobile dealers, snowmobile rentals, travel agencies, Secretary of State Offices, and tourism service providers in snowmobiling areas linked to the designated trail network. Internet information and social media such as the DNR's official website, Facebook and Twitter accounts are other vehicles to disseminate this crucial information. In addition, regarding the danger of speeding, programs and campaigns hosted by snowmobile clubs and organizations, such as the Michigan Snowmobile Association, may be especially effective. Messages that specifically target excessive speeding could utilize "peer pressure" to help reduce accidents and fatalities because of the speed of snowmobiles.

Develop additional rail-trails without car/truck traffic that directly connect community to community

Generally, Michigan snowmobilers perceived low risks in snowmobiling on county/state road shoulders, while 43% of the fatalities occurred on county/state or seasonal roads (Michigan DNR, 2008; 2009; 2010; 2011; 2012; 2013). The fact that Lynch (2000) found very similar results in regards to snowmobilers' low perception of risk from riding on county/state road shoulders suggests the risks of riding on county/state road shoulders should be further emphasized.

Another physical approach that holds promise is the development of additional rail-trails without car/truck traffic that directly connect community to community and are part of the designated snowmobile trial network. Typically, businesses where snowmobilers can access goods (e.g., gasoline, food, etc.) and services (lodging, vehicle repair, etc.) are located on or very near these corridors. The development of this initial transportation link in the 19th and early 20th

century often defined where businesses were initially located. Today, they increasingly provide for tourist traffic flow in both winter and non-snow months by a wide variety of non-motorized trail users such as bicyclists who use these corridors in the non-snow months. With these trails having well groomed surfaces for snowmobiling, the risk of riding on county/state road shoulders and cars/trucks on the road can be avoided or at least reduced through these alternate connections to goods, services and communities as well as providing a scenic riding venue.

Construct voluntary safety patrol programs though local snowmobile clubs and organizations to reduce aberrant riding behaviors

Despite intensified patrol and visibility, Michigan DNR conservation officers and deputies from County sheriffs and city police departments cannot fully cover the extensive snowmobile trail and county/state highway right-of-ways across Michigan. A National Mountain Bike Patrol Program initiated by International Mountain Biking Association (IMBA) focusing on safe and responsible riding provides a potential model for monitoring snowmobiling activities in the state of Michigan. The voluntary safety patrol program can recruit volunteers who are trained with skills and exhibit safe snowmobiling behavior as well as being proficient in first aid, CPR, minor snowmobile repair, and knowledgeable about the area to provide information, directions, and accurate reports of trail conditions or hazards. The volunteer patrollers should follow guidelines and rules developed by Michigan DNR or Michigan Snowmobile Association (MSA), wear a patrol vest, and carry necessary items to ensure quality and visibility. The volunteer patrollers can also partner with a Michigan DNR conservation officer or local unit deputy that can enforce riding rules and regulations. A cooperative model currently used in Michigan involving non-motorized trail users involves the Kent County Sheriff's Department and patrol by trained volunteer cyclists on the Michigan DNR's Fred Meijer White Pine Trail State Park and

Kent County's Kent Trails. It uses 80 volunteers who patrol on scheduled basis in cooperation with the Sheriff's department, who assist trail users and act as eyes and ears for the sheriff's department (Kent County, Michigan, 2014).

Create a snowmobile accident digital profile with geographic coordinates

A geospatial profile with accurate geographic coordinates of those snowmobile accidents resulting in fatalities or injuries that need medical attention will provide comprehensive data for accident investigation. This will facilitate better understanding of possible environmental and human factors involved with serious accidents as well as key spatial data (e.g., relationship to designated snowmobile trails, designated snowmobile trailheads, roadways, etc.). By utilizing accurate locations of snowmobile accidents coupled with accident types and factors, analysts will be able to detect problematic areas on the snowmobile trail system and county/state road right-of-way where managerial actions can be applied accordingly. A similar effort in Michigan's Silver Lake State Park was done by using off-road vehicle (ORV) accident profiles with GPSed, mapped locations, which successfully detected accident hot spots and revealed areas in need of managerial actions such as speed zones and unidirectional traffic areas. In turn this had a positive association with reducing ORV accidents, providing a safer sand dune riding experience (Wu, Borland, & Nelson, 2011). Geospatial technology such as Global Positioning System (GPS) and GIS are becoming increasingly affordable and user-friendly. A hand-held, recreational grade GPS unit offers reasonable accuracy in mapping accident locations even in heavily wooded areas, especially in the leaf-off winter season. Developing such a database requires easy-to-use technology, effort in marking accurate GPS locations and protocols of recording accident details. Appropriate training for those personnel responding to accidents, unified accident reporting forms, and state-wide central database management are crucial beginning steps.

Planning a complete package of development including extension of snowmobile trails and related amenities in northern Lower Peninsula

The high spatial interaction received by regions three and four indicated that the northern Lower Peninsula is the most popular snowmobile destination, with substantial trail mileage, adequate snowfall, abundant natural resources, and close proximity to most of Michigan's snowmobile population which resides in southeastern Michigan. Other research has shown that linking special events and tourist attractions nearby with a supporting transportation network as a fully developed tourism package created a regional approach with strong tourism competitiveness that can obtain an increasing influx of visitation (Lee, et al., 2013; Kim & Fesenmaier, 1990). It is important not only to extend the snowmobile trails, but also better link the goods and services supporting the activity (i.e., lodging, gas stations, and restaurants) and the infrastructure to deliver the services (i.e., roads, internet) to the trail network. Furthermore, a horizontal marketing effort, cooperating with nearby local skiing and snowboarding resorts, special winter events, and other regional tourism attractions, will increase the level of attractiveness to winter recreation enthusiasts. The tourism support system is valuable to non-snow tourism as well, providing the services, goods and infrastructure to other natural resource recreation based tourism year round.

Develop marketing strategies targeting out-of- state snowmobilers

A similar tourism package to that of northern Lower Peninsula should be considered for snowmobile trails in the Upper Peninsula. This research found that expert snowmobilers were willing to travel a long distance (i.e., 445 miles from the Detroit area) in order to access an area with longer trail mileage, more snowfall and outstanding natural resource assets. The economic

benefit brought on by these expert snowmobilers was significant. The natural resources in the Upper Peninsula, with properly developed services and amenities, could attract more out-of-state snowmobilers. When considering non-residents, snowmobile trail investments in both the Upper Peninsula and northern Lower Peninsula have significant potential as both regions are close to key non-resident markets with the western Upper Peninsula close to Wisconsin, Illinois, Minnesota and Iowa and the eastern Upper Peninsula and the northern Lower Peninsula close to Illinois, Indiana, Ohio and Pennsylvania. Studies have shown that snowmobilers from Wisconsin, Illinois, Minnesota, and Iowa visited both western and eastern Upper Peninsula for snowmobiling, while many snowmobilers from Illinois, Indiana, Ohio, and Pennsylvania snowmobiled in Lower Peninsula in winter 2007-08 (Wu, Nelson, & Chang, 2012). Considering the Canadian market from Toronto and surrounding environs, the Eastern Upper Peninsula and the Northeastern Lower Peninsula have the greatest potential. This also provides an opportunity for regional tourism entities such as the Upper Peninsula Tourism Association, West Michigan Tourism Association, Sunrise Side Tourism Association, etc. to market both snow and non-snow attractions to visitors who may already be familiar with Michigan in one or two seasons, but not all four and to complement existing travel patterns.

Research Limitation

In this study, the key limitation is that the state-wide survey was originally designed to study 2007-08 Michigan trail permit purchasers' use of public natural resources and attitudes to multiple managerial actions, instead of measuring recreational specialization and its influences. Though the measurement of recreational specialization closely followed the multi-dimensional structure suggested by the literature, a more comprehensive construct including self-rated skill level and centrality-to-life may yield additional richness in profiling snowmobilers' within-group

social world. Program managers and leisure scholars could benefit from an instrument that was originally and specifically tailored to meet the objectives of this research.

Secondly, this study utilized Michigan snowmobilers who purchased a trail permit in the snowmobile season of 2007-8 in an attempt to understand the within-group social world of snowmobilers and how their respective characteristics influenced their perceived snowmobiling risks and interaction with snowmobile opportunities. The snowmobiler sample in this study represents a small segment of the total range of the worldwide snowmobiling population available. However, it was a valid sample to describe and explain the behavior of Michigan resident snowmobilers entitled to lawfully ride on the designated snowmobile trail system. Data regarding snowmobile trail length and snow precipitation were also limited to a single year. From this point of view, the construct and research procedures described in this research would benefit from a broader snowmobiling population and a longer temporal selection of supporting resources.

In addition, using the most snowmobile friendly point of each destination region to measure travel distance between each snowmobiler's residential origin and destination may have distorted the true travel distance. Unlike many other outdoor recreational activities where participants stay in a relatively small geographic area for the activity, snowmobilers usually trailer their sleds to a starting point and travel on the snowmobile trail system for a long distance. The trail systems are interconnected and often cover several counties and there are even cross state links. Therefore, it is difficult to pinpoint one location to represent the area or region snowmobilers cruised within. However, utilizing the centroid of the county with the greatest product of average snowfall and trail mileage to represent each snowmobiler's destination within the region did provide a scientifically defendable and pragmatic approach to estimate travel

distance. While the measured distance is an objective estimation instead of the precise travel distance for each visit, it is a useful approximation. Future research may benefit from more precise origin destination measurement using GPS devices with respondents or some similar technology.

Lastly, while the calibrations and analysis procedures were based on peer-reviewed journal papers and considered reasonable in addressing research questions, the literature also suggested other measurements and processes. These included different measures of travel cost and destination attributes or a more complex gravity model and statistic method. This is fertile ground for future research inquiry regarding the relationships between snowmobilers' within-group social world and the perception of risk and spatial interaction.

Future Research

This study should be viewed as a starting point for examining the recreational specialization of snowmobilers, their perception of risks, and the spatial interaction between the availability and accessibility of snowmobiling opportunities and demand. While certain relationships among three key concepts were revealed by this research, future research should focus on the following.

First, future research should focus on a broader range of snowmobilers to further investigate the within-group social world of the participants and the activity. A study with the sample of snowmobilers from other jurisdictions in the Upper Midwest such as states of Wisconsin and Minnesota, as well as Canada, and Scandinavia countries will provide a more complete coverage of the snowmobile population. This diverse research sample will enhance the scholarly understanding of snowmobile within-group social world and perhaps reveal

distinctions among jurisdictions/origins. Further, conducting a longitudinal study with snowmobilers to investigate the role of snowmobiling in their range of leisure pursuits and at various stages of their life will greatly improve not only the knowledge of snowmobiler social world, but also the development and progress of recreational specialization in this activity. In addition, little work has been done in relationship to other motorized adventure recreation (e.g., ORV riding), which would benefit from a study fully designed and tailored to understanding recreation specialization. This would be complicated by the distinctly different mature of different types of off-road vehicles (e.g., motorcycles, ATVs, larger specialty vehicles such as dune buggies, etc.).

Such studies could include a more focused survey instrument with additional key skill/knowledge and centrality-to-life measurements. Other statistical analysis methods such as structural equation modeling and logistic regression may also be applied to investigate further the influence of recreational specialization on perception of risks and spatial interaction. Which behavioral, skill/knowledge, and psychological attachment dimension has more explanatory power to those two concepts can be examined in detail. In the attempt to provide a more holistic understanding of snowmobile social world, qualitative methods provide another alternative that can be used to obtain insights regarding snowmobilers' leisure pursuit. Research questions such as "what does snowmobiling mean to snowmobilers?", "how do snowmobilers progress through recreational specialization continuum?", or "how does snowmobiling experience in the early childhood affect snowmobilers' leisure participation in their later life?" have yet to be investigated. An in-depth interview or a participatory action research may offer answers to the questions stated above.

Second, to reduce the incidence and severity of snowmobiler accidents requires an examination of cognitive, affective, and behavioral dimensions of snowmobiling besides perceptions of driving risks. More detailed general demography, likelihood of risk-taking in general, one's propensity for sensation seeking, and circumstantial decision making are just a few constructs utilized in accident and traffic research in studying risky driving behaviors. Different taxonomic approaches in segmenting snowmobilers such as the subgroups produced by cluster analysis may offer different perspectives of assessing the influence of recreational specialization on perception of risk. Other action research such as using a riding stimulator, GPS tracking mechanisms and helmet cameras may provide meaningful behavioral results outside of the behavioral intentions or reported behaviors discussed in a survey.

Third, while spatial availability and accessibility as destination attributes and friction functions in the traditional gravity model presented a general indication of spatial interaction between snowmobile supply and demand, other calibrations such as destination attractiveness, visitor preferences, and different means of friction parameters and exponentials will deepen scholarly understanding of spatial interaction between snowmobilers and their destination trail network. Friction parameters such as travel time, travel cost, cognitive distance, road network distance, or population weighted distance, will provide other selections in a gravity model. Using more detailed travel and destination information such as a specific destination down to the trail head or specific city/town will also increase the accuracy of the model. Moreover, the association between recreational specialization and spatial interaction can be improved by a more complex gravity model such as the two-step floating catchment area (2SFCA) method that looks at differential travel distances or time thresholds, as has been used when measuring health care accessibility (Luo & Wang, 2003). Snowmobilers who resided within a distance threshold

receive one friction parameter while those lived outside of the threshold receive another, such that the severe skewness of measured spatial interaction distribution can be partially accounted for.

Lastly, using observed visitation, in this case snowmobile days, coupled with origin and destination attributes, may provide the opportunity to model spatial interaction between origin and destination. This is the ultimate target in investigating spatial interaction. Once the model is proven accurate and valid, inertia effects can be applied to explain how increasing the length of snowmobile trails in one area or decreasing friction in terms of distance would affect general snowmobile travel flow between demand and supply. The constructed model will provide valuable evidence and reference for future resource management and program planning.

Conclusion

The study improves the understanding of the within-group social world of snowmobilers. Further, as no published literature has studied this social world and directly examined the effects of recreational specialization on recreationalists' perceived risks and spatial interaction with recreation resources, this exploratory research clearly adds to the literature. It does this by explaining how personal characteristics are associated with an individual's cognitive understanding of risky riding behaviors, as well as their preference for travel destinations. The within-group social world of snowmobilers presents program managers with insights useful in developing marketing plans, policies, and managerial strategies to protect health and safety. In a dynamic tourism environment with the aging baby boomers and incoming tourists brought in by the "Pure Michigan" marketing campaign, program managers, policy makers, and law enforcement must embrace the on-going change in snowmobiles, trails and those who ride. They

need to utilize newly developed technology to more efficiently and effectively manage natural resources and recreation programs. Tailored managerial actions for targeted populations and informational messages in trusted modes and venues are important strategies for sustaining recreation programs, protecting rider safety and responding to change.

Partnering with local enforcement units and recruiting enthusiastic volunteers to become helping hands and eyes and ears on the snowmobile trails are additional alternatives in safeguarding riding enjoyment. Geographic information systems with new spatial analytical tools provide powerful, commonplace, and easier-to-use analysis to study recreation behaviors from a spatial aspect. Social media offers an effective marketing reach at relatively minimal cost to those seeking winter excitement living outside of Michigan.

Finally, thinking in the longer term with predicted climate change, snowmobiling will be on the forefront of adaptation to a warmer climate. A Canadian climate change impact assessment predicted that snowmobile season will reduce by 24% in the 2020s and 33% in the 2050s at Sudbury, Ontario, which is located about 160 miles east of Sault Ste Marie, Michigan at a similar latitude with the Upper Peninsula. Orillia, Ontario, 260 miles east of Grayling, Michigan (located at a similar latitude with the northern Lower Peninsula) was projected to lose 44% of the snowmobile season in the 2020s and 56% in the 2050s (McBoyle, Scott, & Jones, 2007). Therefore, trail venues in the Upper Peninsula, linking heavier snowfall with colder temperatures than the Lower Peninsula and the rest of the Great Lakes region and still benefiting from lake effect precipitation and cloud cover, could make Michigan's Upper Peninsula a great national and not just a regional snowmobiling destination in the years to come. Snowmobiling and the trail system are important assets for the State of Michigan. Continuing research efforts

and the best practices of managing social and natural resources are keys to a sustainable, well-administered snowmobile program of the future.

APPENDIX

Questionnaire

1. Please complete the following table to describe the people in your household and their involvement in snowmobiling. If there are no people in a certain category, please write 0 for that category.

	# in household	# who snowmobiled Winter 2007-08	# who snowmobiled Winter 2008-09	# who have completed a snowmobile safety class
Adults 18 or older				
Children 12-17				
Children 11-younger				

If no one from your household snowmobiled in Michigan during Winter 2007-08 or Winter 2008-09, please skip to Question 7.

2. For each snowmobile your household owns, please complete the table below about last year's and this year's snowmobiling. Please circle the correct y=yes or n=no regarding use, trail permits and registration and be sure to fill in the number of miles each machine was driven in MI.

Model year	CC	Used in MI winter 2007-08?	Used in MI winter 2008-09?	Had 2008 MI Trail Permit?	Has 2009 MI Trail Permit?	Current MI Registration	Approx # MI miles driven winter 07-08	Approx. # MI miles driven so far winter 08-09
		y n	y n	y n	y n	y n		
		y n	y n	y n	y n	y n		
		y n	y n	y n	y n	y n		
		y n	y n	y n	y n	y n		
		y n	y n	y n	y n	y n		

3. Please estimate, using the table below, how many Michigan SNOWMOBILE DAYS you and household members operated your snowmobile(s) in Michigan last winter and so far this winter. A SNOWMOBILE DAY IS EACH DAY OR PART OF A DAY ONE SNOWMOBILE WAS OPERATED in Michigan unless it was primarily used to support other activities like ice fishing. For a region or winter in which your household did not snowmobile, leave that spot blank. Please add the total days for each year on the last line, even if it is 0.

Region (see map)	MI Snowmobile Days Last Winter (2007-08)	MI Snowmobile Days This Winter (2008-09)
1 Western UP		
2 Eastern UP		
3 NW NLP		
4 NE NLP		
5 Southern LP		
Total Snowmobile Days		

3a. Did you use any of your snowmobiles to support ice fishing, trapping or some other recreational activity in winter 2007-08? ___yes ___no … or winter 2008-09? ___yes ___no

4. How many of these TOTAL SNOWMOBILE DAYS from Q3 were mostly spent on the Michigan designated snowmobile trail system (trails marked with orange diamonds)?

Last winter (2007-08) ____# days
This winter (2008-09) _____# days

5. How many gallons of gasoline did your household use in all of its **snowmobiles** <u>in Michigan</u> during winter 2007-08 _____ # gallons and so far this winter (2008-09) _____# gallons.

6. Of the total MI SNOWMOBILE DAYS last winter and this winter (last row in Q 3 above), how many were from which type of trip?

Type of trip	Last Winter (2007-08)	So far this winter (2008-09)
Days involving overnight stays away from permanent home	# days	# days
Days not involving overnight stays away from permanent home but with travel of 100 or more miles one way to snowmobiling site/area	# days	# days
Days not involving overnight stays and less than 100 miles from home	# days	# days
ALL SNOWMOBILING DAYS (should equal "Total Days" from last row of Q3)	# days	# days

Now, for your <u>most recent</u> Michigan snowmobiling outing when you stayed overnight away from home <u>or</u> snowmobiled more than 100 miles from your permanent home, please answer questions 7-13. This outing likely occurred during winter 2008-09.

7. When did the MOST RECENT outing begin? Month ____ Date ____ Year ____

8. In which region of the state was it **primarily** focused? (Please check one) __ Western UP __ Eastern UP __Northwestern LP __Northeastern LP __Southern LP

9. How many people from your household _____# and how many of your snowmobiles _____# were involved during that **MOST RECENT** outing?

10. How many total snowmobile days were your machines used for snowmobiling (not as support for fishing) during that **MOST RECENT** outing? _____# days

11. Did the outing involve an overnight stay away from your permanent home? __Yes __No (go to Q 12)

11a. If you stayed overnight away from home, where did you stay? Please check all that apply.

____ Own second home ____ Motel/hotel/rental cottage or cabin
____ Camped ____ At friend's/relative's
____ Other (please explain_____)

11b. In total, how many nights did you spend away from home on this trip? _____# nights

12. How much money did your household spend on the entire trip during that **MOST RECENT** outing? Please complete the table below for spending at home in preparation, traveling to and from the snowmobiling area, and in the area where you rode. If you spent nothing on an item, please leave it blank.

	At Home	En Route	Local Area
Grocery & convenience store food/drink	$ .00	$ .00	$ .00
Tow vehicle expenses (gasoline, repairs, etc.)	$ .00	$ .00	$ .00
Snowmobile expenses (gasoline, repairs, etc)	$ .00	$ .00	$ .00
Restaurant and bar meals and drinks	NA	$ .00	$ .00
Sporting goods (bait, fishing tackle, etc.)	$ .00	$ .00	$ .00
Lodging (motel, rental cabin, etc.)	NA	$ .00	$ .00
All other items (clothing, souvenirs, etc.)	$ .00	$ .00	$ .00

13. Whom did these expenditures cover? ____# from your household + ____ # others?

14. What were your household's MI snowmobiling related expenses in the last 12 months in the following categories? If there were no expenses for a category in MI, leave category blank.

Expense Item	Dollars spent in last 12 months
Purchase of snowmobile	$
Purchase of snowmobile equipment other than snowmobile (trailer, clothing, etc.)	$
Snowmobile repair/maintenance	$
Insurance on your snowmobile(s)	$
Off-season storage costs	$

Now, I'd like to ask some questions about Michigan snowmobiling and its management.

15. Please rate the following services/situations regarding the Michigan DNR's snowmobile program. Use a scale of 1 to 5, with 5 as very good, 4 as good, etc. **Please CIRCLE the appropriate number for each item.**

Services/Situations	**Very Good**	**Good**	**OK**	**Poor**	**Very Poor**	**Why your Rating?**
Public trail grooming	5	4	3	2	1	_____
DNR snowmobile trail maps	5	4	3	2	1	_____
Snowmobile trails	5	4	3	2	1	_____
Snowmobile trail signage	5	4	3	2	1	_____
Public trail design	5	4	3	2	1	_____
Trailhead parking/staging	5	4	3	2	1	_____
Snowmobile law enforcement	5	4	3	2	1	_____
Snowmobile safety education	5	4	3	2	1	_____
DNR snowmobile website	5	4	3	2	1	_____

16. Overall, how satisfied are you with Michigan snowmobiling on a scale of 1 (highly dissatisfied) to 5 (highly satisfied)? ____# rating

What is the ONE most important reason for your rating? _____

17. Is the public snowmobile trail system in Michigan overcrowded? ____ Yes ____ No

18. Please list the ONE improvement you would most like to see in the Michigan snowmobile trail system.
_____

19. Would you be willing to pay more to snowmobile in Michigan to pay for this suggested improvement?

____ Yes ____ No ____ Undecided

19a. If yes, please check the highest **additional** amount you would annually be willing to pay per snowmobile for **this** suggested improvement? __$5 __$10 __$15 __$20

20. It has been proposed that the State of Michigan acquire permanent easements or invest in longer term leases for the portions of the designated snowmobile trail system that are on private lands if the current owners are willing. It has also been proposed that such an approach should be used to expand the current snowmobile trail system. Please circle your level of support for each of the following options on a scale of 1-5, with 5 as strongly support, 4 as moderately support, down to 1 strongly oppose.

Action	Strongly Support	Moderately Support	Neutral	Moderately Oppose	Strongly Oppose
More long term trail leases held by non-profit snowmobile organizations/clubs	5	4	3	2	1
More long term trail leases held by State of MI	5	4	3	2	1
Permanent trail easements held by non-profit snowmobile organizations/clubs	5	4	3	2	1
Permanent trail easements held by State of MI	5	4	3	2	1
Expand the mileage of the designated MI snowmobile trail system	5	4	3	2	1

21. Would you be willing to pay more to snowmobile in Michigan to pay for longer term leases or permanent easements for more of the snowmobile trail system?

____ Yes ____ No ____ Undecided

21a. If yes, please check the highest **additional** amount you would annually be willing to pay per snowmobile for long term leases/permanent easements? __$5 __$10 __$15 __$20

22. Over winter 2007-08, 25 snowmobilers were killed during Michigan snowmobiling. The DNR is considering potential ways to reduce fatalities. **Please circle your level of support for each of these on a scale of 1 to 5, with 5 strongly support, 4 moderately support, etc.**

Fatality Reduction Initiative	Strongly support	Moderately support	Neutral	Moderately oppose	Strongly oppose
Enforced snowmobile speed limit on all public lands, designated trails and waters	5	4	3	2	1
Enforced snowmobile speed limit on all designated trails only	5	4	3	2	1
Enforced snowmobile speed limit where posted on designated trails only	5	4	3	2	1
Mandatory safety training for all first year snowmobile operators regardless of age	5	4	3	2	1
Licensing required of all snowmobile operators	5	4	3	2	1
Mandatory personal liability insurance for all snowmobile operators	5	4	3	2	1
Snowmobile curfew/closed hours on designated trail system	5	4	3	2	1
More intensive enforcement of existing snowmobile regulations	5	4	3	2	1

23. Please list any other ideas you have about ways to reduce fatalities?_____
_____

24. Would you be willing to pay more to snowmobile in Michigan to have fatality reduction initiatives? ____ Yes ____ No ____ Undecided

24a. If yes, please check the highest **additional** amount per snowmobile
you would annually be willing to pay to have fatality reduction initiatives? __$5 __$10 __$15 __$20

25. In total, considering all potential improvements to the Michigan snowmobile program discussed above including the one improvement you would most like to see, efforts to make a more permanent and perhaps larger designated snowmobile trail system and fatality reduction initiatives, how much **more in total** would you be annually willing to pay per snowmobile?

__ $0 __$5 __$10 __$15 __$20 __$25 __$30

26. How many times during winter 2007-08 in Michigan were you or members of your household checked or stopped by a law enforcement officer while snowmobiling? ____# Winter of 2008-09?_____#

If you or another household member were stopped or checked by an enforcement officer one or more times, please check which type of officer(s) was involved.

___ DNR Conservation Officer
___County/City/Other local unit officer/deputy

27. Did you or members of your household see, but were not stopped or checked by a law enforcement officer while snowmobiling in Michigan during winter 2007-08?____ Yes ____ No
winter 2008-09?____Yes ____No

28. Please rate the level of danger to snowmobilers from the following, based on your snowmobiling experiences. Use a rating scale of 1 to 5, with 5 being extremely dangerous, 4 highly dangerous, etc. and **circle the appropriate number for each.**

Behavior/Situation	**Extremely Dangerous**	**Highly Dangerous**	**Moderately Dangerous**	**Slightly Dangerous**	**Not Dangerous**
Operation of snowmobile by person who has been drinking but is not legally intoxicated (0.01-0.07 blood alcohol)	**5**	**4**	**3**	**2**	**1**
Operation of snowmobile by a legally intoxicated person (0.08 or higher blood alcohol)	**5**	**4**	**3**	**2**	**1**
Speed of snowmobile	**5**	**4**	**3**	**2**	**1**
Driver lacking skill in operating machine	**5**	**4**	**3**	**2**	**1**
Cars/trucks on seasonal roads	**5**	**4**	**3**	**2**	**1**
Public trail conditions	**5**	**4**	**3**	**2**	**1**
Public trail design	**5**	**4**	**3**	**2**	**1**
Other uses of designated snowmobile trails (e.g. dog sledding, cross country skiing)	**5**	**4**	**3**	**2**	**1**
Snowmobiling on county/state road shoulders	**5**	**4**	**3**	**2**	**1**

29. List other behaviors/situations that you feel are extremely/ highly dangerous. _____

_____

I would like to finish with some general questions about you.

30. Please check **all** of the recreation activities in which you participated during the past 12 months.

__Snowmobiling	__ORV riding	__Open water fishing	__Hunting
__Camping	__Canoeing/kayaking	__Power boating	__Horseback riding
__Hiking	__Wildlife viewing	__Ice fishing	__Mountain biking
__Cross country skiing	__Paved trail/road biking	__Pick wild mush./berries	__Trapping

31. What is your 5 digit home zip code? _____ 32. What is your age? _____years

33. At what age did you begin snowmobiling? _____ years

34. Are you a member of a snowmobiling association or club? __No __Yes (please list each organization

_____)

Please write any other comments you have about Michigan snowmobiling here.

Please mail the completed questionnaire back to me in the postage paid envelope provided. Thanks for your assistance in helping to improve Michigan snowmobiling.

Dr. Chuck Nelson
131 Natural Resources Building
Michigan State University
East Lansing, MI 48824
(517) 432-0272

Initial Survey Cover Letter

January 15, 2009

Dear Michigan Snowmobile Trail Permit Purchaser:

The Michigan Department of Natural Resources (DNR) and Michigan State University (MSU) are cooperating to better understand Michigan snowmobile use and users. This research study is a follow-up to one done a decade ago by MSU for the DNR. Using that baseline information, it provides the opportunity to track trends in snowmobiling since the late 1990s. You have been randomly selected as one of the 3,000 trail permit purchasers to be sampled from the winter 2007-08 list of almost 225,000 snowmobile trail permit purchasers.

The enclosed questionnaire asks about your household's snowmobiling during last winter (2007-08) and this winter. It also asks about your most recent snowmobiling outing (most likely this winter). In addition, it provides the opportunity for you to evaluate Michigan's snowmobile program, suggest program improvements and enhance snowmobiling safety. Please take the 15-20 minutes needed to complete the questionnaire and mail it back to me in the postage paid envelope.

Your participation is voluntary. You can withdraw or refuse to answer any question without penalty. There are no known risks associated with your participation in this study. Rather, your participation in this study will contribute to a better understanding of Michigan snowmobiling and provide guidance for future program direction.

Your responses will be kept confidential and your name will not be associated with any results. Your privacy will be protected to the maximum extent allowable by law. If you have any questions about this project at any time, please call Dr. Chuck Nelson, Associate Professor at MSU by phone (517) 432-0272 or by email at nelsonc@msu.edu.

Thanks for helping to better understand and improve Michigan snowmobiling.

Sincerely,

Dr. Chuck Nelson,
Associate Professor
Enc.

Second Mailing Survey Cover Letter

February 15, 2009

Dear Michigan Snowmobile Trail Permit Purchaser:

About a month ago I sent you and some other randomly selected snowmobilers a survey about your experiences and opinions on Michigan snowmobiling. While I have received completed surveys from many others, I have not received yours. If our correspondence has crossed in the mail, please accept my apologies for contacting your again. If you have not yet responded, please do so using the enclosed survey. Your opinions are important. My goal is to be able to accurately represent the collective views of those who snowmobile in Michigan in my report to the DNR. Let your voice be heard. Please take the 15-20 minutes needed to complete the survey and then mail it to me in the postage paid envelope. I will not be contacting you again about this matter.

Your participation is voluntary. You can withdraw or refuse to answer any question without penalty. There are no known risks associated with your participation in this study. Rather, your participation in this study will contribute to a better understanding of Michigan snowmobiling and provide guidance for future program direction.

Your responses will be kept confidential and your name will not be associated with any results. Your privacy will be protected to the maximum extent allowable by law. If you have any questions about this project at any time, please contact Dr. Chuck Nelson, Associate Professor at MSU by phone (517) 432-0272 or by email at nelsonc@msu.edu.

Thanks for helping to better understand and improve Michigan snowmobiling.

Sincerely,

Dr. Chuck Nelson,
Associate Professor
Enc.

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