

Incorporating social spatial data in sustainable management: Mapping tourism-recreational activities of locals and tourists in Hood Canal, Washington using ArcGIS.

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Abstract

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The Hood Canal watershed is a saltwater fjord that provides ample and diverse opportunities for tourism and recreational activities such as camping, boating, shellfishing, swimming, and hiking. The current tourism literature does not have a strong focus on local recreation trends and whether locals partake in different recreational activities than tourists who visit the same region. In order to address this gap, I collected and analyzed social spatial data using an online map survey to understand the activities of Hood Canal locals and people who visit the region. InSEAM, an online tool, was used to test if this method is useful in gathering spatial data. The survey asked various demographic questions and perception questions about the health of the Hood Canal and the impact of tourism-recreational activities. On the actual map, participants drew polygons, lines or points to represent locations of where they enjoy tourism/recreational activities. I

recoded the data into seven larger categories and analyzed using ArcGIS and a Pearson χ^2 test.

Non-motorized shore activities accounted for the most activities done in Hood Canal. Results show there are differences among the types of activities locals and tourists participated in as well as in their perception of how their activities impacted the overall health of the Hood Canal.

InSEAM was effective in collecting data stored in GIS format and removed the need to digitize paper maps or convert them into GIS formats. It provided a simple way to engage stakeholders by allowing them to complete the survey at their convenience. To make the tool more effective, educational information about mapping should be sent out to users beforehand. The results provide tourism brokers, local residents, tourists and managers with visual representations of how the watershed is being used for recreation and tourism purposes by locals and by tourists.

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INTRODUCTION

The interdisciplinary field of marine and environmental affairs focuses and studies the intersection of natural systems associated with human/social systems. In order to study human uses of natural resources and environmental impacts on humans, we must integrate law, policy, economics, and science. Applied research is used to address a variety of topics such as climate change, natural resource management, risk analysis, sustainable economic development, marine transportation, and tourism and recreation. Practitioners in the field make significant contributions to government, non-governmental organizations, private sectors and academia.

A central theme in marine and environmental affairs is sustainable growth and management in coastal communities. One factor affecting coastal communities is increasing development and demand for leisure opportunities. Tourism and recreational activities influence both the society and the environment that the activities take place in. In any tourist destination, there exists a system of brokers, locals and tourists that each play a role in affecting the local community and the surrounding environment. This system includes the activities engaged in by tourists and visitors, the recreational activities by local residents, and the business and policy decisions generated by the people who manage and govern the area. These activities may produce positive, neutral or negative impacts on either the environment or the society or both. A method to studying the impacts is by analyzing visitation trends and use. Understanding outdoor and tourism recreation trends is a critical aspect of sustainable resource management and tourism management. An overarching goal is the ability to have tourism/recreation opportunities exist while minimizing the negative impacts on the environment.

The approach to understanding recreation and tourism has taken many forms and in recent years, geographic information systems (GIS) methodology has surfaced as a particularly useful tool for land use management and tourism. GIS is a unique tool because it allows for analysis on both non-spatial data and spatial data and provides tools to visual spatial data in a variety of ways. GIS has been applied to a variety of coastal areas and can be a valuable resource when examining social-ecological systems in the Pacific Northwest.

Plan of the Thesis:

This thesis represents an application of an online GIS methodology to examine tourism recreational activities of locals and tourists in Hood Canal, Washington. The research assessed the concentrations of mapped activities in order to fully understand the constituency and stakeholders that make up the Hood Canal tourism system. This study utilized an online GIS method for gathering recreation/tourism data and provides suggestions on how to interpret and use social spatial data to guide management decisions. The geospatial data hopes to inform policy makers on how to make decisions that will ultimately improve the activities and enjoyment of people who use the region. By understanding tourism/recreational trends, policy makers could make decisions that would positively impact tourists, recreationists and the environment.

This thesis is divided into two parts. Part I, includes Chapters 1-3, discusses key concepts about tourism, recreation and participatory GIS and tourism mapping programs as well as a theoretical background for the study. Chapter 1 provides a literature review in order to define coastal and marine tourism and recreation and how it has been studied. Chapter 2 focuses on GIS and how

GIS mapping has been applied in management and tourism. Chapter 3 describes the methodology and findings of several GIS mapping projects in recreational areas.

Part II of the thesis, includes chapters 4-7, is a case study of tourism/recreational activities in Hood Canal, Washington. Chapter 4 gives an overview of the research site and describes the location, geography, climate as well as a management organization in the region. Chapter 5 chapter provides details on the development and implementation of the survey design and the online software used to host it, and introduces the research questions and hypotheses. This thesis examined the overarching question of what pattern of leisure activities are exhibited in the Hood Canal watershed. Other research questions focused on the effectiveness of the tool, perceptions of the respondents about the health of the Hood Canal, differences between tourists and locals, and if the sample size is representative of and overall densities of mapped activities seen in Hood Canal. Chapter 6 presents the results and patterns found in the data as well as a summary of demographic information about the respondents and responses to survey questions. Chapter 6 also provides maps to visually represent the activities done in Hood Canal and any differences between the two subgroups: tourists and locals. Chapter 7 interprets the results provided in chapter 6 makes recommendations on how managers/brokers can use social spatial data and about the tool itself. The Conclusion summarizes the results and discussion sections and provides remarks on additional research opportunities and general applications this methodology has to other places.

The methodology, findings and recommendations of this thesis will be useful to a diverse audience such as practitioners in the field of marine and environmental affairs, natural resources

managers and the public who enjoy Hood Canal, Washington. These recommendations can also be useful to researchers studying marine and coastal tourism in other social-ecological regions.

PART I: CONCEPTS AND LITERATURE REVIEW

Part I provides a literature review that is intended to inform readers about the different types of tourism and recreation that this research focuses on as well as different management strategies. This section will also introduce GIS and public participation GIS as a tool to analyze human behavior and how it can be applied in management. It will also provide examples of similar research conducted using mapping principles and/or online methods.

Chapter 1 – Marine and Coastal Tourism and Recreation

1.1 Tourism as a social-ecological system

Throughout history, humans have interacted with the natural environment for a variety of benefits and reasons such as food, shelter, beauty, art, and water. Over time, ecosystems have been altered by human impact and these alterations then impact their well-being. This interaction between humans and the natural environment has been defined and given a variety of names in the scientific literature

such as “coupled human and natural systems”, “social-ecological systems” and “complex adaptive systems”

(Collins et al., 2011; Holling, 2001; Levin, 1998; Liu et al., 2007; McLeod & Leslie, 2009).

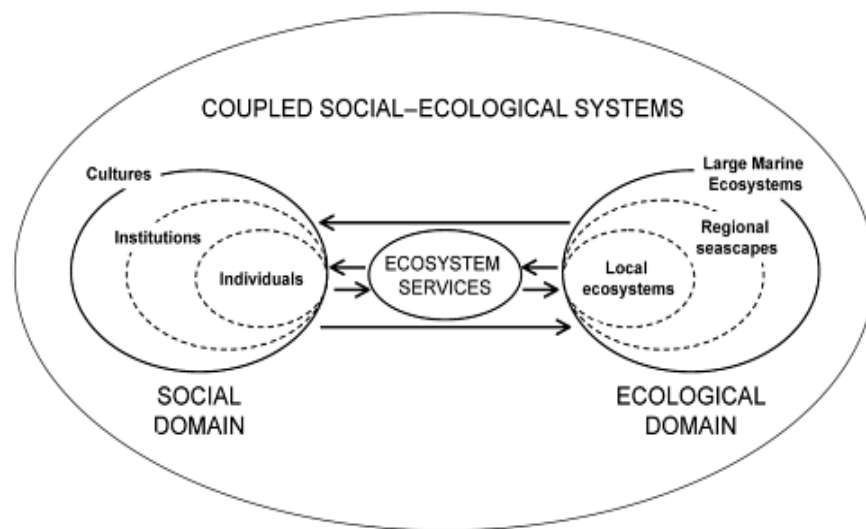


Figure 1: Visualization of Coupled Social-Ecological Systems. This figure represents the interaction between the ecological domain on the right and the social domain on the left at different geographic and organizational scales. Ecosystem services connect the domains and the flow of services into each domain is affected by both social and ecological factors (McLeod & Leslie 2009).

The ecological/natural system includes the flora and fauna as well as the abiotic components such as nutrient availability, temperature, and sunlight. Frameworks used to study these complex systems tend to focus on the dynamic relationship between the two systems and the reciprocal interaction between the humans and the environment and how each system affects the other. As seen in both Figure 1 and 2, the link between the human/social system and the natural/ecological

system is ecosystem services or the benefits that humans receive from the environment that contribute and promote well-being (Collins et al., 2011; Fagerholm, Käyhkö, Ndumbaro, & Khamis, 2012; McLeod & Leslie, 2009). Ecosystem services can be divided into four components: provisioning, regulating, cultural and supporting and are the foundations of employment, economics, and well-being in the social system (Plieninger et al., 2013). Collins et al. (2011) discuss a framework that focuses on understanding how human behaviors affect ecosystem process through pulse and press events (see Figure 2).

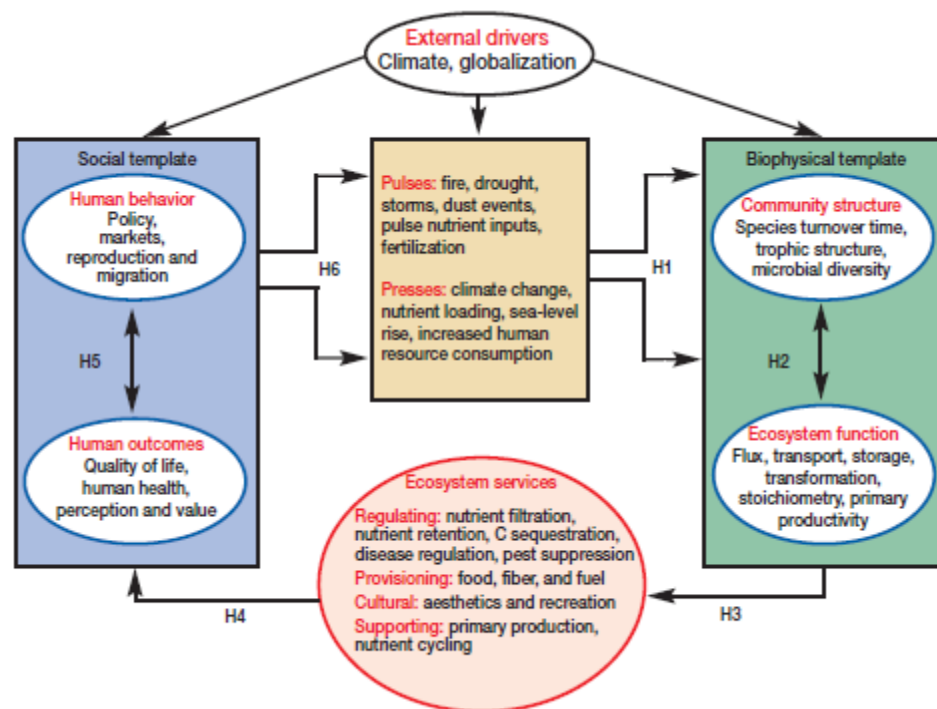
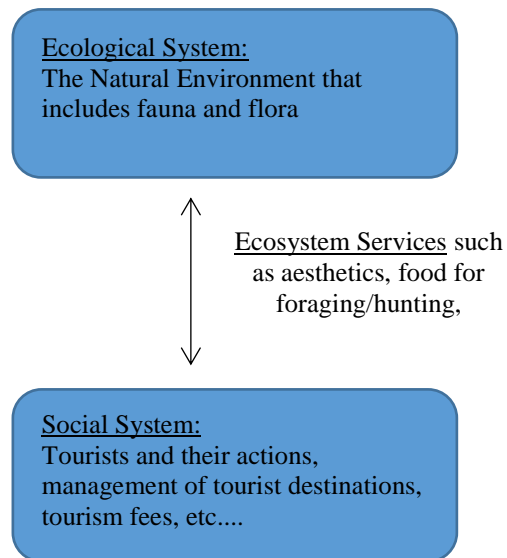


Figure 2: Framework for studying social-ecological systems (Collins et al. 2011). The right hand side of the framework represents the natural system and on the left hand side represents the human dimensions of environmental change. They are linked by ecosystem services provided as well as pulse and press events that are influenced by human behavior.

Tourism/recreation represents an example of a social-ecological system, as it is highly dependent on the benefits provided from the environment through ecosystem services. Tourism not only promotes economic wellbeing but also affects an individual's physical wellbeing, learning and quality of life (Tallis et al., 2012). The natural environment provides ecosystem services such as cultural and provisioning services that attract tourists to certain destinations for its beauty,

cultural significance, edible plants to forage, clear waters to swim and fish and wildlife to hunt, (Figure 3). Understanding the interactions between the biological and human dimensions of this system is essential in evaluating tourism impacts and how to properly manage the system.



1.2 Tourism as an activity and industry

Tourism as an activity typically involves travel to a destination and is defined in a variety of ways.

Figure 3: Tourism as a social-ecological system. The natural environment provides tourism/recreational opportunities through clean water, views, wildlife, plants, and natural forests.

The Oxford dictionary generally defines tourism as “the commercial organization and operation of vacations and visits to place of interest” (Oxford Dictionary, 2012). The World Tourism Organization defines tourism in a more narrow scope as “the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes” (United Nations World Tourism Organization (UNWTO), 1995). These definitions are either too broad or too specific for analyzing recreational/tourist activities but both encompass the general notion that when considering tourism, a person travels to a place of interest.

Miller and Auyong (1991) add to this definition the notion of a tourist returning home after visiting a tourist destination. **For this thesis, I define tourism as the activity of any person traveling to a place of interest, either local or distant, for any purpose such as leisure, business and other purposes, and then returning home.**

Tourism has become one of the largest and fastest growing industries, competing closely with oil, automobile and food industries and continues to expand and diversify (Miller, 1993; United Nations World Tourism Organization (UNWTO), 2013). International tourism comprised about 6% of worldwide exports of goods and services in 2003 and based off tourism receipts in 2011 the industry generated around \$1,075 billion in 2012 US dollars in export earnings (United Nations World Tourism Organization (UNWTO), 2013). The tourism industry, both internationally and nationally, is expected to experience continued growth and increase economic development. In 2012, tourism in the United States grew by 5.2% and specifically, in Washington State, visitation increased by 2.1% and spent \$16.9 billion (WA Tourism Alliance, 2013). Local and state tax receipts generated over \$1 billion from travel spending, an increase of 4.9%. In Washington, tourism is the fourth largest industry (based on Gross Domestic Product produced) behind the software, aerospace and agricultural and food industries and supports more 153,300 jobs in 2012 and generated earnings of \$4.7 billion in Washington (WA Tourism Alliance, 2013).

The tourism industry is closely integrated with the social and ecological system of the tourist destination and can have positive and negative impacts on that system. Tourism can increase employment opportunities, increase revenue, raise the standard of living for locals, as well as protect and preserve natural environments (Kreag, 2001). Tourism can simultaneously degrade natural environments, may interfere with cultural traditions, reduce authenticity, cause inflation, and create conflict (Kreag, 2001). In order to support this industry, many organizations spend a large proportion of resources and time on managing the environment and land use and resources.

Understanding how tourists interact with the ecological system is important in effectively managing that social-ecological system.

Tourist numbers have also continued to increase by 4.6 % since 2010 (UNWTO, 2013). The increasing number of tourists seen worldwide limit the ability to effectively manage the environmental and social pressures such as excessive use of transportation, food, water, and energy, exerted by tourists on a location. These pressures may also be increased by residents in the tourist destination who also partake in similar activities but may not identify themselves or their activities as touristic. However, through proper management and governance, negative impacts may be minimized and can lead to conservation of a region or species as well as promote tourism as a positive and rewarding experience (Stronza & Pêgas, 2008; Wilson & Tisdell, 2003; Zeppel, 2008).

1.3 Broker-Local-Tourist (BLT) Model

In any tourism destination, there exists a sociological tourism model that is comprised of brokers, locals, and tourists (Miller & Auyong, 1991) (Figure 4). A broker refers to anyone who is involved in the tourism industry that may interact with tourists, directly or indirectly (Miller, 2008). These brokers can be further subdivided into the private sector,

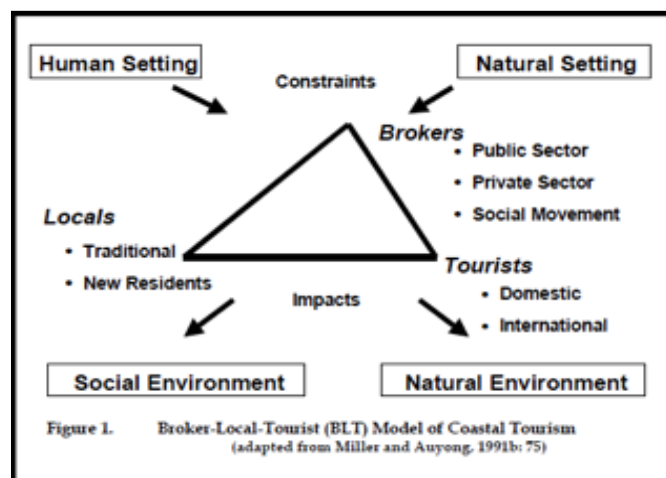


Figure 4: Broker-Local-Tourist (BLT) model. This model shows the interactions between all three actors in the tourism model, which is comprised of brokers, local and tourists (Miller et al., 2002)

the public sector and organizations that “have programmes or initiates that address tourism issues as well as the behavior of other kinds of brokers” (Miller, 2008). Examples of private sector brokers are hotel owners and managers, marinas, shop owners, tour agencies, tour boat operators, and tour guides. In the public sector, there are brokers who are involved at “various levels of the government who study, regulate, and plan tourism” (Miller, Auyong and Hadley, 2002) such as the Ministries of Tourism, Washington Tourism Alliance, US National Park Service, and park rangers. Lastly, there are “social movement brokers in non-governmental, non-profit, and environmental organizations who address tourism issues” such as the People for Puget Sound (Miller, Auyong and Hadley, 2002).

The tourist in the system refers to any person partaking in any activity due to their own motivation at a destination and subsequently returning home (Miller, 2008). Miller, Auyong and Haldey (2002) have defined tourists as people with “domestic and international origin who travel for relatively short periods of time for business, recreation, and educational purposes before returning home”. These tourists may live within the same state/country or far away in distant countries to the tourist destination. To be considered as a tourist, a person must visit a destination that is not their home region.

Lastly, locals are considered those “who reside in the general vicinity of a tourism destination but who do not depend on tourism for an income or seek in any organized way to control tourism” (Miller, 2008). At any point in time, a person or organization may only be classified as one of these components. However, there can be shifts in their status where tourists can become locals, brokers can become tourists, and locals can become brokers, and so forth.

Each sector can impact the other, positively or negatively, as well as influence one another. The negative impacts of tourists will in turn have the public sector (government institutions and agencies) focus and create policies and regulations to manage tourist activities. This will not only impact the tourists but also the private sector brokers by potentially increasing fees to access a park or increasing hotel taxes. As shown in Figure 4, the actions of tourists and locals will also impact the function and structure of the social-ecological system, which will potentially create more constraints that the brokers will have to address when managing the tourism destination.

For this thesis, I will extend the BLT model to a recreation/tourism sociological model where the tourists are the ones who come to a place and then go home and locals partake in recreational activities in their area and brokers are dealing with the needs of the tourists. For the purpose of this thesis, residents of a tourist destination can be classified as either brokers or locals.

Residents who are brokers play a double role in this system as they bring in tourists and sometimes participate in recreational activities. Locals have no connection to the tourism industry and may visit the same areas as tourists, but do it for recreation purposes, not as a form of tourism. Recreation is similar to tourism, but does not involve the aspect of returning home. In general, it is an activity that occurs during leisure time that involves the natural environment (Wood, 2012).

Much of the literature focuses on how tourist activities impact local residents' perception and attitude of tourism, the conflict that may arise between the two groups or tourist motivations behind choosing specific tourist destinations and tourist satisfaction (Kozak, 2002; Manning &

Valliere, 2001; Mason & Cheyne, 2000; Meng, Tepanon, & Uysal, 2008; Ryan & Glendon, 1998). Tourists participate in a specific activity in order to achieve a personal benefit or value such as “social connection to the community, physical fitness or individual satisfaction” (Luck, 2008). Tourist motivation is dynamic and may vary from tourist to tourist and can depend on the season and the country of origin of the tourist (Kozak, 2002).

Push and pull factors also factor in influencing tourist motivation and deciding on a tourist destination (Kozak, 2002). Push factors determine the motivations behind why a person decided to travel while pull factors refer to why tourists decide to visit a specific tourist destination (Meng, Tepanon & Uysal, 2008). Examples of push factors are knowledge, economy, convenience and interest and examples of pull factors are safety, specific activities, historical/cultural aspects and marketing strategies (Meng, Tepanon & Uysal, 2008). Tourist motivations have been grouped into four general components: social component, an escape from everyday life component, an intellectual component and a challenging component (Ryan & Glendon, 1998). There are a variety of research opportunities to studying tourists but little research has focused on comparing and analyzing trends of both residents and tourists in the same area.

When tourism increases in a destination, local residents have shown behavioral and cognitive responses either as direct effect of the increase of tourists to the area or through the regulations put in place in order to manage the tourist destination (Manning & Valliere, 2001). Local residents still recreate in the same areas as tourists but have shown to change the time, day and even season such as partaking in the recreational activity during the week or in the off season

(Manning & Valliere, 2001). The current tourism literature lacks focus on local recreation trends or motivations and if locals partake in recreational activities in different locations than tourists within the same tourist destination.

1.4 Types of Tourism and Recreational Activities

There are many sub-categories of tourism such as nature-based tourism, sport tourism, ecotourism, pro-poor tourism, adventure tourism, mass tourism, marine tourism and sex tourism (Ceballos-Lascurain, 1996; Fennell, 2001; Hall & Brown, 2006; Hudson, 2003; Oppermann, 1999; Orams, 1999; Valentine, 1990). The list is endless, with many overlapping and sharing similar characteristics, and where every individual can find the type of tourism that best fits their interest. This section defines recreation, highlights the differences between tourism and recreation and discusses the different types of tourism that are relevant for this thesis (nature-based tourism, ecotourism, wildlife tourism, and marine and coastal tourism).

Recreation is defined as participation “within an activity in which the individual freely chooses to participate during leisure time, or in time away from work or other commitments and responsibilities” (Luck, 2008). These activities are done for pleasure rather than income or duty and provide a benefit such as physical fitness or community connections or satisfaction (Ashworth, 1984; Luck, 2008). Recreation can be experienced as an indoor or outdoor activity and provides the participant with an enjoyable and purposeful experience that can increase an individual’s quality and satisfaction of life. Activities can be physical such as swimming, biking, and fishing or non-physical such as sunbathing and shell collecting (Luck, 2008). A recreational activity is done within the home region of a person while a tourist activity is done outside of the

home region. Those home regions where people recreate are home to locals from the BLT model (See Section 1.3) and may serve as tourist destinations for tourists. The types of tourism that are discussed in this thesis occur in the natural environment as well as also creating the basis for recreational activities. For the purpose of this thesis, recreation will be defined as any nature-based activity that is done by a person in a local region that is consumptive or non-consumptive. Consumptive activities remove the resources from the environment so that other people cannot use them in the future while non-consumptive activities leave the environment more or less in the same quality for people to enjoy in the future. Tourism does encompass recreational activities but the person partaking in the activity is not from the local region and travels in order to participate in the recreational activities. Simply put, tourists are non-locals who participate in recreational activities which are referred to as tourism activities.

This thesis focuses on the most relevant types of tourism that emphasize solely some aspect of the natural environment. The tourism literature provides a variety of types as well as many definitions for each type of tourism. Nature-based tourism (also referred to as nature tourism in the literature) is a broad form of tourism that connects people to nature. It is broadly defined as the experiences, enjoyment, activities and attractions that are directly related to nature and the natural environment (Honey, 2002; Valentine, 1992; Weaver, 2008). Examples of nature-based tourism are excursions to parks and wilderness areas and travel to countries with highly concentrated biodiversity unspoiled/undisturbed natural areas. Tourists travel with the primary purpose of visiting a natural destination in order to experience and enjoy nature.

Nature-based tourism is described as being a larger section of ecotourism since they both occur in the natural environment but it is not solely encompassing as it does not include 4 major themes found in the literature: conservation, culture, benefits to the locals, and education (Fennell, 2001). One of the earliest definitions of ecotourism, Ceballos-Lascurain (1987) defines it as the travel to

“...relatively undisturbed or uncontaminated natural areas with the specific objective of studying, admiring, and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations (both past and present) found in these areas.”

Honey (2002) defines ecotourism simply as the “responsible travel to natural areas that conserves the environment and sustains the well-being of local people”.

Wildlife tourism is also described as another subset of nature-based tourism but also encompasses the built environment and

focuses more primarily on animals (Newsome, Dowling, & Moore, 2005). The main focus of wildlife tourism is the wildlife itself, rather than the natural environment as a whole. Wildlife tourism and ecotourism may overlap in the notion of conservation through sustainable and responsible practices. For wildlife tourism to be sustainable in the natural environment the tourist activity must limit

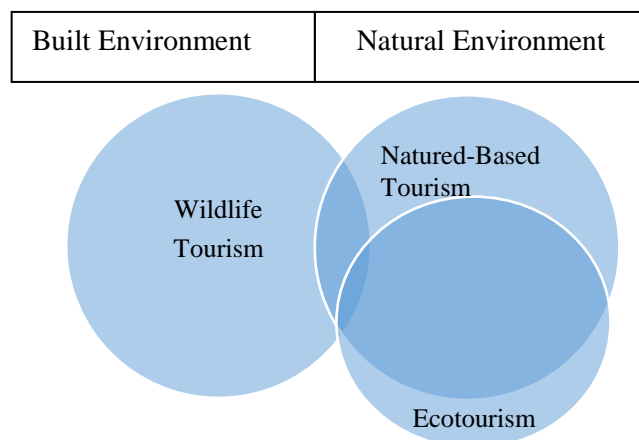


Figure 5: How the built v. natural environment fits into wildlife tourism and nature-based tourism/ecotourism. The overlap between nature-based tourism and ecotourism is the location: the natural environment. The overlap between nature-based tourism and wildlife tourism is the wildlife that attracts tourists. In nature based tourism, wildlife is seen only in their native habitat while in wildlife tourism, a species may be seen either in captivity or in its native habitat.

the number of visitors and the size of the area visited as well as promote education to reduce impacts and incorporate a fee structure that directly benefits conservation projects (Boersma, 2008). Proper management of the natural environment is essential for maintaining the wildlife it supports. Wildlife tourism may also occur in captivity, and may be consumptive or non-consumptive (Higginbottom, 2004; Newsome, Dowling & Moore, 2005). There is a lot of controversy about whether consumptive tourism should be considered as wildlife tourism or ecotourism since consumptive activities tend to not foster conservation (Newsome, Dowling & Moore, 2005) but for this research, wildlife tourism will encompass both consumptive and non-consumptive activities.

Marine coastal tourism is also a subset of nature-based tourism but specifically takes place in the marine environment and has shown similar rapid growth patterns to the tourism industry (Miller, 1993). In order to understand marine coastal tourism, it is important to understand each component; marine tourism and coastal tourism. Marine tourism can occur in wetlands, beaches, underwater, bays, any area with coastal waters (Miller, 1993). Orams (1999) defines marine tourism as “recreational activities that involve travel away from one’s place of residence and which have as their host or focus the marine environment (where the

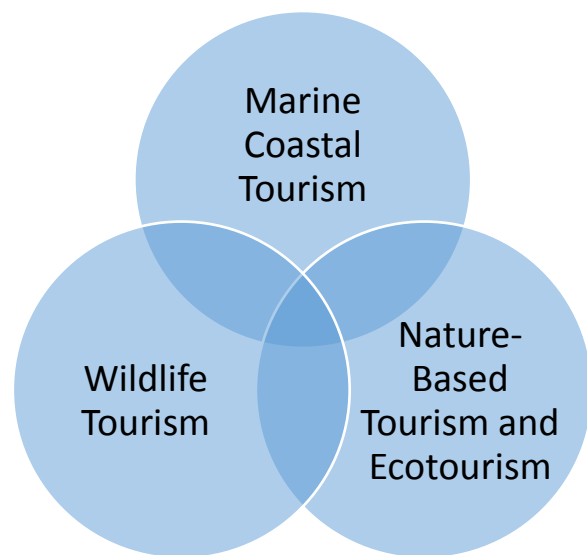


Figure 6: Overlap between nature-based tourism/ecotourism, wildlife tourism and marine/coastal tourism

marine environment is defined as those waters which are saline and tide-affected)” Orams’ definition is important because it shows that marine tourism also occurs along the shoreline and is limited to the boundaries of coastal water sources. Marine tourism is unique in that it occurs in an environment that is inaccessible by humans unless with the aid of technology such as boats or scuba gear and is growing at a faster rate than most of the tourism industry (Orams, 1999).

Coastal tourism refers to the activities that occur in the coastal zone and the offshore coastal waters (Miller, Auyong & Hadley 2002). Coastal tourism destinations can be found in urbanized settings or in minimally inhabited areas but require tourist accommodations that range from camping sites to luxury hotel suites (Miller, Auyong & Hadley 2002). These coastal tourism accommodations can foster economic relationships between the tourist, brokers and even within the local community (Miller, Auyong & Hadley 2002). Marine and coastal tourism offer a variety of activities to tourists such as beach-combing, kayaking, whale watching, fishing and deep-sea fishing, shellfishing, bird watching, scuba diving, surfing, swimming, snorkeling, boating, and cruises. When discussing tourism or recreation herein, it is referring to both tourism and recreational activities.

Tourism discussed in this thesis will draw on aspects from wildlife tourism, nature-based tourism and ecotourism that are found in marine and coastal tourism. The tourism types discussed earlier all possess aspects to marine and coastal tourism but are not synonymous. Marine and coastal tourism have been found to show similar trends in growth to tourism as well as an increase in the scientific literature. Orams (1999) conveys that in the early 1990s, very few papers, periodicals and journals focused on marine tourism. Since then, there have been seven Coastal Marine

Tourism Congresses to increase collaboration and share research among practitioners, students and academics. In addition, a journal was created that focuses solely on marine and coastal tourism, *Tourism in Marine Environment*. Similarly, there has also been a shift in tourism planning and management. Traditionally, it has focused on “land use zoning, site development, accommodation and building regulations, the density of tourist development, the presentation of cultural, historical and natural tourist features, and the provision of infrastructure including roads and sewage” (Hall, 2001). Tourism planning has been factoring in aspects of social-ecological systems through integrated management practices (Hall, 2001).

1.5 Integrated Management Strategies

Integrated management strategies such as ecosystem-based management and integrated coastal zone management have arisen in order to address the complexities of social ecological systems. The marine environment is highly dependent on a functioning ecosystem which is impacted by human actions. Negative human outcomes on a resource-sensitive area that is also a tourist destination can be attributed to poor management, unsustainable development as well as inappropriate behavior (Kuo, 2002).

Ecosystem based management (EBM) provides an integrated approach to managing social-ecological systems that looks at the cumulative impacts of different sectors as well as the trade-offs (McLeod & Leslie, 2009; UNEP, 2011). The main goal is to maintain a healthy, productive and resilient ecosystem so it can provide the various benefits that humans need. EBM also acknowledges that natural boundaries are more relevant to management than legal boundaries as it is a place-based approach with the ecosystem representing the place (UNEP, 2011).

Similarly, the practice of integrated coastal zone management (ICZM) “analyzes [the] implications of development, conflicting uses, and interrelationships among physical processes and human activities” in order to achieve sustainability (Cicin-Sain & Knecht, 1998). The four main goals of ICZM are maintaining a functional integrity of the coastal resource, reducing resource-use conflicts, maintaining a healthy environment and facilitating integration among different sectors. These goals are crucial in obtaining a successful management (Beatley, Brower, & Schwab, 2002). It can be an “effective tool for advancing towards sustainability in the coastal zone, ensuring equitable use of coastal resources (natural, socio-economic and cultural) and integration among the different administrative and societal sectors” (Diedrich, Tintoré, & Navinés, 2010).

Both of these management tools create more informed decisions as they are science based, and increase participation of various professionals, stakeholders and sectors. They are also an alternative way of thinking as they both embrace learning from experience and adapting policies throughout the process (UNEP, 2011). Tourism managers and natural resource managers must balance the enjoyment and opportunities people obtain from the natural environment with the need to sustain healthy ecosystems by incorporating the characteristics found in EBM and ICZM. Tourism management has to incorporate different government and nongovernment organizations, various scales (national, regional, local and sectoral) and various times (C. M. Hall, 2001) which can be achieved through these management strategies.

Marine planning is another management tool that addresses challenges such as multiple and conflicting uses of the marine environment, economic and development priorities and conservation goals (National Ocean Council, 2013). This process is again science based but adds into the process engaging the public. The National Ocean Council (2013) created a handbook to aid in marine planning that states that participation of stakeholders with varying levels of interest and resources is essential to marine planning and suggests a number of options for engaging the public and stakeholders such as conferences, focus groups, survey, workshops, public meetings, public comment periods and stakeholder committees.

Engaging the public allows for the incorporation of local knowledge into management plans. This practice has shown to be important in solving land-use challenges (Fagerholm et al., 2012) and can be done through public comments, meetings and education/outreach. Education programs can instill long lasting changes in tourists more effectively than imposing restrictions on access, providing security at a location or implementing rules and regulation to limit activities (Kuo, 2002). Providing educational materials and interpretative information effectively can influence a person's behavior by enhancing their knowledge and alleviate negative impacts of their actions. Inappropriate tourist/recreationist behavior that can negatively impact the natural environment can occur either because "a person was not aware of, or not made aware of, the sensitivity and value of the destination" (Kuo, 2002). A structured education program alongside a direct experience, in Tangalooma, Australia showed a desire in tourists to change their behavior and become more environmentally responsible (Orams, 1997). Similarly, after an education program was instated in a local community in Indonesia's Raja Ampat MPA network, there was an increase in local resident's knowledge and more positive attitudes about

environmental protection (Leisher et al., 2012). Coastal marine tourism (CMT) planning should incorporate aspects from EBM and ICZM in order to develop sustainable tourism management plans. All three actors in the tourism system should be engaged throughout the process as stakeholders and the public.

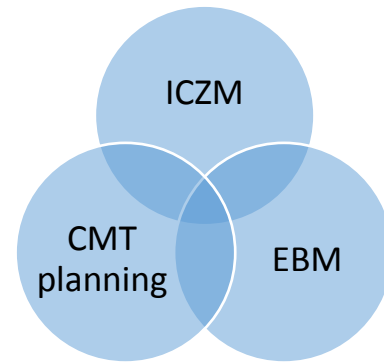


Figure 7: Relationship between coastal marine tourism planning, ecosystem-based management and integrated coastal zone management.

Much of the literature in managing tourists has focused on instilling behavior change through education, but little is mentioned about tourists engaging in public participation of managing a tourist destination. In the following chapter, an analytical tool is described that can be used in tourism management.

Chapter 2 – Geographic Information Systems (GIS) to Explore Recreation Trends

2.1 Geographic Information Systems (GIS)

A new trend for analyzing and understanding marine-based recreation/tourism is to spatially identify different activities. Holland (2006) identifies the roles of computer-based models as a way to increase our understanding of social-ecological systems. A geographic information system, more commonly known as GIS, is a computer system that captures, stores, queries, analyzes and displays geospatial data. This type of data describes the location and characteristics of spatial features. GIS software has the ability to define different layers of a map which are the visual representation of different aspects of any particular area or map. GIS layers can be thought of as slices of that map or similar to a legend item found on a paper map (Wade & Sommer, 2006). For example, on a watershed map, different layers would be made up of county boundaries, roads, rivers, lakes, trails, wetlands. Each layer represents a specific ecological or social component that makes up that area.

One type of layer is known as a feature layer which refers to a set of feature data. This data represents geographic objects and come in the shape of a polygon, line or point. Each type of feature represents something different. A line feature can represent roads or streams, a polygon feature can represent lakes or counties, and a point feature can represent objects or places such as cities, landmarks or buildings. Polygons represent a place or thing that has a given area at a specific scale, lines have a given length at a specific scale and points have neither area nor length. Users can run analyses on the different features and/or layers. GIS software is also capable of storing quantitative and qualitative demographic information that is stored in the layer file. This information storage allows a user to analyze different attributes or values (such as area

or length) for a specific area. Displaying spatial information on maps through GIS software can enable viewers to see patterns and trends that may not have been apparent otherwise seen in tabulated data or many independent paper maps.

GIS is unique to other types of data/information systems, such as database management systems and desktop mapping, because it has the ability to integrate “spatial and non-spatial data in order to support both display and analysis needs” (Shaw & Rodrigue, 2013). Visualizations and analyses can show stakeholders involved in the management process current trends, various predictions under different scenarios and different planning strategies.

GIS plays an important role in natural resource management and has been used in land use planning, natural hazard assessment, wildlife analysis, riparian zone monitoring, timber management, emergency planning, and in public health departments (Chang, 2010). Advances in technology have increased the availability and capability of collecting spatial data that can be used to study social-ecological systems. This thesis will focus on specifically on participatory GIS (PGIS), which incorporates social spatial data collected from the public into GIS, and how it can be used in tourism planning.

2.2 Participatory GIS (PGIS)

One way to incorporate stakeholder (such as tourists and tourism brokers) and local knowledge into decision making is through participatory GIS (PGIS). PGIS is also referred to as public participation GIS (PPGIS) and community-integrated GIS in the literature. All emphasize community involvement and the incorporation of local knowledge into the production and use of

geographical information (Craig, Harris, & Weiner 2002). PGIS incorporates “aspects of community development, capacity building, public access to official data”, inclusion of underrepresented populations, provides a wide range of data for practical implement and “links social theory and qualitative research tools” (Dunn, 2007). PGIS involves local communities by collecting information that can be fed into GIS software and can subsequently be used in decision making and promote the goals and objectives of nongovernmental organizations and grassroots organizations (Sieber, 2006). The incorporation of local knowledge should create better information that will aid in the development of appropriate responses and policies (Craig, Harris, & Weiner 2002).

There is no single tool used in PGIS. One approach “combines digital spatial information tools such as remote sensing and spatial analysis with participatory research methods such as participatory mapping and diagramming, and use of photographs, video clips and oral histories through sound” (Dunn, 2007). Community mapping projects typically have participants use paper map and stickers that represented certain attributes of a location (Alessa, Kliskey, & Brown, 2008; Brown & Donovan, 2014; Brown et al., 2004; McLain et al., 2013; Veilleux, 2013). These stickers would be placed on a map and the specific location would be digitized and put onto a GIS map to be analyzed. Then participants are asked to respond to survey questions that allow for correlation analyses between the responses and the placement of the stickers. Typically, the community is not directly involved with the GIS or the analyses but they do provide the spatial data and evaluate/see the output (Sieber, 2006). The data and outputs can be used in resource management, land planning decisions and tourism development.

Increasing access to the internet through handheld devices has provided researchers with a way to collect data from a wider range of people as well as skip the digitizing step. Instead of stickers, participants are asked to place digital markers or annotations on an online map such as Google Maps (Brown & Donovan, 2014; Brown & Weber, 2012). When comparing paper map surveys to online map surveys, the major difference between the two methods was in the response rate. Participants that used the online map had lower response rates and marked fewer locations (Brown & Donovan, 2014; Veilleux, 2013). In both online and in-person survey formats, participants would need to understand “basic cartography and vector representations of points, lines, and areas” (Sieber, 2006).

Although the Internet provides a convenient platform for PGIS, it is essential to thoroughly test the ease and usability of the survey and map before launching it to the public to ensure high participation (Steinmann, Krek, & Blaschke, 2004). Online map surveys may be more difficult for participants if they do not have a basic understanding of GIS and maps but could allow for easier participation since each participant can take the survey on their own time. The website can also be easily augmented by online help and tutorials to help users when needed. Researchers save time by removing the digitizing stage and can go straight into data analysis.

The biggest barrier to PGIS is how to motivate stakeholders and citizens to learn about GIS and mapping in order to increase their participation in decision making processes. PGIS also has the potential to influence decisions or program, either intentionally or accidentally, depending on what stakeholders were asked to participate in the project/survey (Sieber, 2006). PGIS is a distinctive approach to engage the public in the decision making process by incorporating and

analyzing local knowledge. It can also be applied across a variety of academic disciplines, organizations and at different scales and sectors.

2.2.1 Human Ecology and Human Ecology Mapping

PGIS commonly collects data about human uses and associated values of the land, which is a key aspect of the field of human ecology. Human ecology is broadly defined as the study of human interactions with the environment. It is a “transdisciplinary science that focuses on understanding human environmental interactions by ‘tracing chains of effects through ecosystems and human society’ with the goal of anticipating long-range environmental effects of human activities” (McLain et al., 2013). Research looks at the impacts of social, cultural and psychological factors on ecosystems and the effects of population growth on health, social organization and environmental quality. A subset of human ecology is mapping of values, which identifies and visualizes human activities in the environment and addresses the connections people have to the surrounding landscape (McLain et al., 2013). Various mapping projects have been conducted that allow respondents to mark on a map different places that have meaning to them and describe what value they associated with that spot (see Chapter 3).

2.3 GIS and PGIS in Tourism

Specifically within tourism, GIS and PGIS are widely applicable tools that can be used to collect, analyze, model and represent visually tourist data (Taranto, 2007). It can facilitate modeling and forecasting to achieve sustainable tourism development. Analysis within a GIS can measure tourism impacts, measure visitor traffic, analyze relationship associated with a particular resource or amenity, assess potential impacts of tourism development, determine locations for

tourism development, and provide visual information on where tourism resources are located. In fact, layers in GIS can be associated with different components of the BLT model. Amenities provided by brokers, such as hotels and campgrounds, are all spatially oriented and can be designated as a layer similar to roads or streams (Figure 8).

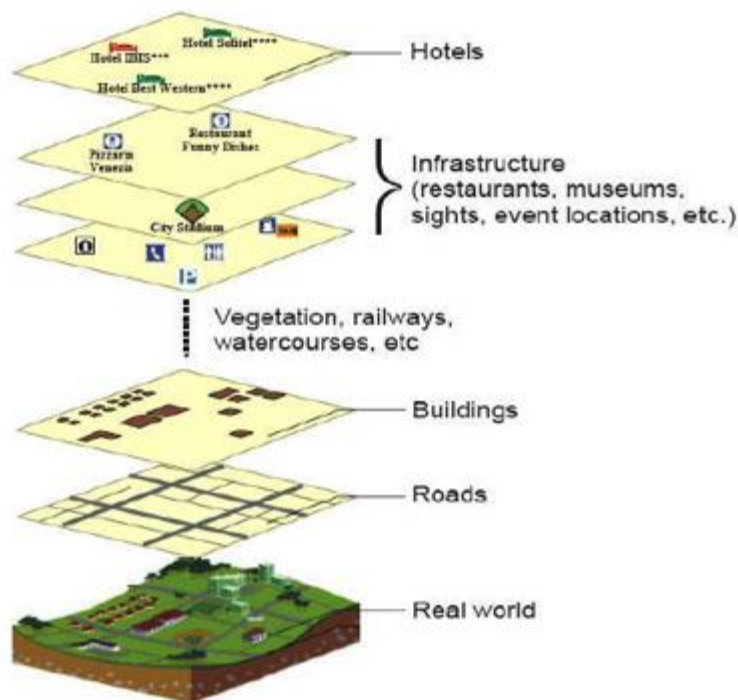


Figure 8: Extended Layer Model. This figure shows the different layers (roads, buildings, hotels, vegetation, etc...) that make up the 'real world' (Kushwaha, 2012).

Presenting data in a GIS can have advantages to both tourists and to brokers. Maps and general information about the area have long served as a strong tool when selecting a tourist destination. Maps allow tourists to visually see tourist destinations and what type of tourist infrastructure is available in the area they are travelling to. With GIS, tourists can combine data from a variety of sources and run different queries to search for their ideal destination or area in which to participate in activities. A tourist may run a query on a map of the area to see how many hotels

are located within 2 miles of a certain attraction such as a forest, beach, or trail. These queries can be based on distance from cities/towns, public access to shoreline, state park, elevation, availability of streams nearby, etc...Locals can also look at tourist amenities and decide if to avoid certain places and go somewhere less crowded. GIS allows brokers to develop interactive maps that respond to specific queries that a tourist may specify. GIS can provide information on effectiveness of transportation infrastructure, zoning, utilities in the area as well as provide a tool for planning and selecting new sites (Shaw & Rodrigue, 2013). Brokers can use data collected from PGIS to determine which facilities or infrastructure need updating or where to open new facilities. Incorporating GIS into management decision allows for better informed actions to be taken based on real world data.

GIS is especially useful in tourism planning because it can incorporate data from all three actors in the tourism system. However, there has been a limited use of GIS by tourism planners and research even though most topics involving tourism is spatial (Brown, 2006; Hasse & Milne, 2005). Typically, physical landscape characteristics have been mapped and not preferences and values of locals and tourists (Brown, 2006). This could be because preference and value data is not readily available, is not in spatial form and there is high spatial variability associated with the data (Brown, 2006). There has been recent attempts to assess tourist time/space behavior by mapping tourist use of the physical environment but beyond simple maps, there has been few examples of direct use of GIS in sustainable tourism planning (Hasse & Milne, 2005). PGIS provides a way to improve community and local participation in coastal marine tourism planning by supporting discussion among participants and providing a new and innovative way to participate in planning (Hasse & Milne, 2005).

Chapter 3 – Mapping Projects

This chapter provides five examples in the literature of research that has incorporated public participation and mapping in order to gain further insight about either recreation or local value and knowledge in various social-ecological systems.

3.1 The Natural Capital Project

The Natural Capital Project (NatCap) is a collaboration between the Stanford University, the University of Minnesota, The Nature Conservancy and the World Wildlife Fund. Their mission is to integrate ecosystem services into the decision making that affects the environment and human well-being and to ultimately improve the state of biodiversity and human wellbeing. NatCap works to “develop scientifically rigorous approaches to incorporate natural capital into decisions, create innovative software tools to model, map, and values nature’s benefits to society, and engage influential leaders to advance change in policy and practice” (The Natural Capital Project, n.d.). NatCap has different projects around the world to scientifically test and improve tools and approaches that can be used in natural resource decisions. There are projects in China, Belize, Vancouver Island, and in the United States. One tool developed by NatCap is InVEST which is an acronym for Integrated Valuation of Environmental Services.

InVEST is free and open-source software that is used to inform and improve natural resource management and investment decisions (The Natural Capital Project, n.d.). It is a scenario development tool that is used in conjunction with GIS software and helps users quantify, map and value the goods and services from nature that contribute to human wellbeing. InVEST enables decision makers to assess tradeoffs associated with different management strategies.

There are a variety of models ranging from hydropower production, offshore wind energy, biodiversity to recreation. These models describe “natural resources in terms of their biophysical supply, the service they provide to humans, or their projected socioeconomic value” (The Natural Capital Project, n.d.).

A recreation model was created in order to understand how the environment influences recreation. The model uses geotagged photos posted to online websites as a proxy for visitation to understand people’s decisions about where they choose to recreate (Tallis et al., 2012; Wood, Guerry, Silver, & Lacayo, 2013). Geotagged photos are useful because they provide information about who uploaded the photo as well as when the photo was taken. Wood et al. (2013) ran a linear regression analysis to compare geotagged photos from Minnesota State Parks to actual visitor data collected from park gates. The study revealed a positive relationship that supports using geotagged photos as a proxy for actual visitation rates. One limitation of using geotagged photos is that it may create bias towards tourism and ignores local recreation from local residents in the area who may not take pictures when they regularly visit the park (Wood, 2012). The model provided estimates on how various attributes of the landscape, such as location, distance from a city, accessibility, and built features impact visitation rates. The model is also applicable to any recreation area and does not require a lot of data to be available. The output of the model provides maps that show current trends in recreational use and future trends under various alternative scenarios.

3.1.1 InSEAM

Another tool created by The Natural Capital Project is InSEAM: **InVEST ScEnArio Modeler**.

InSEAM is a web based tool for community mapping and was developed as a tool to gather stakeholder based geospatial information for NatCap site projects such as dive sites in Belize and tourist destinations in Vancouver Island. In Belize, researchers compiled spatial data on human activities and coastal and marine ecosystems through “government agencies, research centers and universities, trade associations and environmental organizations” (Clarke et al., 2012). InVEST provided “information about the location, quantity, and value of ecosystem services, and tradeoffs” such as increased revenue from tourism versus habitat degradation and decreased revenue from lobster fisheries (Clarke et al., 2012). InSEAM was used to collect data from stakeholders about their preferences on zoning by electronically adding lines, points and shapes onto a base map. This map allowed researchers to model the impacts that different zoning schemes will have on lobster fisheries, tourism and recreation, and coastal protection in order to aid in the creation on an ICZM plan.

Gathering stakeholder spatial data can be collected by online tools, in person workshops or surveys. When stakeholders draw on printed maps it has to be digitized to be used in GIS.

InSEAM removes the need to digitize maps since it imports information directly into GIS. Users can add lines, polygons and points to signify activities in particular areas as well as provide metadata for those shapes (Sharp, 2012). This is particularly useful in reaching out to a wide variety of stakeholders who can virtually provide information on their own time.

3.2 The Olympic Peninsula Mapping Project

In 2010, a Human Ecology Mapping Project was conducted for the Olympic Peninsula, Washington to identify the various connections people have to the region. The project looked at where activities occur and what places have special value. Eight workshops were held around the region and participants were asked to “identify 3 to 5 places where they engaged in their favorite outdoor activities” as well as “to locate places that had particular meaning for them and why” (Cervený, n.d.). Participants were provided an identifiable colored permanent marker in order to independently map on a clear sheet of Mylar that covered a printed 3’ X 3’ map. A total of 169 individual maps were then digitally scanned and analyzed using geospatial tools. They were then given a worksheet packet to record names of the mapped locations, assign values and activities associated to the locations, and provide qualitative data about the mapped sites and demographic data (McLain et al., 2013).

The workshops were held in Port Angeles, Port Townsend, Quilcene/Brinnon, Hoodspport, Shelton, Aberdeen/Hoquiam, Quinault, and Forks. The vast majority of recreational activities that were identified in and around the peninsula included hiking, boating, fishing and foraging. For the Hood Canal region that overlaps with the Peninsula, top five activities were identified as (1) walking, hiking and climbing, (2) logging, (3) fishing, (4) hunting and (5) photography. Consumptive recreational activities were identified to occur at about 2X more area than non-consumptive activities (2,114,043 acres v. 1,151,222 acres).

From the workshops conducted in Port Townsend, Hoodspport, Quilcene/Brinnon, and Shelton recreational activities constituted 75%, 69%, 78% and 78% (respectively) of the activities mapped by participants (Cervený, n.d.). Residents of these areas also associated pre-identified

values to places, with recreation being a common value selected in all of the workshops conducted in the Hood Canal region.

This project identified general patterns among workshop participants “in the distribution and intensity of meaningful places and the values attached to them” as well as the distribution of locations of outdoor activities and the types of activities done at those locations (McLain et al., 2013). The information collected and analyzed is best suited for regional level planning and can be used to guide land management decisions. It can be particularly useful when combined with other data about the region, such as proximity to cities/roads and existing amenities, in order to make better decisions.

3.3 Oregon Non-Consumptive Recreational Use Study

In 2010, the Surfrider Foundation, Ecotrust and NaturalEquity collected spatial and economic data on non-consumptive recreational activities done along the Oregon coast (LaFranchi & Daugherty, 2011). The goal of the survey was to develop a quantitative baseline, estimate economic impacts of recreational activities, create a monitoring tool, and provide geospatial data that can be incorporated into Oregon’s Territorial Sea Plan. An online geospatial survey was created that allowed respondents to draw points and polygons on an interactive map (OpenOcean Map) in response to different questions about their visits. Information was collected on demographics, coastal activities undertaken if they had visited the coast within the last 12 months, frequency and distribution of those activities and the expenditures associated with the most recent trip to the coast (LaFranchi & Daugherty, 2011).

Two methods were used to recruit participants to the survey: an internet panel and an opt-in option. The internet panel is similar to a random digital dial or random mail back survey as it uses “random samples of a large, pre-selected group of volunteer respondents” who have already agreed to participate in surveys through a panel hosted by Knowledge Networks (LaFranchi & Daugherty, 2011). Data was collected during winter and summer to capture for seasonal effects and had a response rate of 4,072. The opt-in survey was a non-random process since individuals provided their email contact and were then given a link to the web survey. Prior to the opt-in survey, the Surfrider Foundation conducted extensive outreach and recruitment strategies that involved direct mails, leaving postcards at businesses about the survey and attending meetings of organized groups. The opt-in survey had a response rate of 254 and allowed for a participatory approach to include stakeholders. Data from the opt-in survey was not used to draw conclusions, generate findings related to demographic or economic impacts to the area or compared to the internet panel results (LaFranchi & Daugherty, 2011). Even though this process is not random and had a low response rate, the participatory approach may increase the likelihood that stakeholders will trust the results of the survey and accept the decisions made based off the results.

The geospatial data was categorized into four activity groups: ocean (human powered); wildlife viewing, boating and shore activities (LaFranchi & Daugherty, 2011). Activities grouped into the ocean recreation group were kayaking, surfing, swimming, SCUBA diving, snorkeling and skim boarding. The wildlife viewing group was characterized by activities such as tide-pooling, bird watching and whale watching. Boating activities included sailing, power boating, windsurfing, kite boarding, personal water crafts and tow-in surfing. Shore-side recreational activities were

the most popular activity group which included beach going, scenic enjoyment, storm watching, bike/hike, off-road vehicles and photography. 65% of respondents specified that they participated in shore-based activities such as beach going and scenic enjoyment while wildlife viewing activities only accounted for about 33% and ocean-based activities 2-8%. Overall, 88% of the trips taken to the coast by residents were for the primary purpose of recreation and the activities were non-consumptive in nature. These recreational activities were found to contribute significant economic and social benefits to the coastal communities and the state. The average respondent spent around \$88 per trip which was estimated to be around 2.4 billion dollars in total direct expenditures.

When compared to US Census Bureau data, the demographic profile of the respondents represented well the target population, with the exception of some female overrepresentation and Latino underrepresentation. Data from the opt-in survey was not used to generate findings related to demographic profile or economic impacts because the sample was non-random. Several other benefits of using an online survey with an internet panel were revealed from this research such as data collection could be easily replicated and scaled, the data provided a baseline to monitor recreational activities and impacts, the survey was cost efficient compared to other survey techniques and it provided estimates of coastal use and economic impacts (LaFranchi & Daugherty, 2011). The results are now integrated into a decision support tool for ocean planning (Oregon MarineMap) in hopes that the data will be used for future analyses by stakeholders and policy makers in order to minimize potential future impacts and avoid conflict. The results were shared with Oregon's Department of Fish and Wildlife. In 2013, The State of Oregon approved

their Territorial Seas Plan that identified locations suitable for potential development that did not conflict with high use recreational areas (Nelsen, 2013).

3.4 Kangaroo Island, Australia

In 2004 and 2010, PGIS surveys about tourism preferences in Kangaroo Island, Australia were sent out to local residents of the island (Brown & Weber, 2012; Brown, 2006). In 2004, Brown



Figure 9: Kangaroo Island Online Map and Survey.

collected preferences about tourism development through the use of paper maps of the area and dot stickers (Brown, 2006). Each participant was asked to visually represent where there should be no tourism development and where there could be using the dot stickers. In 2010, Brown and Weber (2012) reached out to the same participants and households of the 2004 survey but instead of a paper map, provided each potential participant with an access code and a link to an online map survey. Participants in the 2010 survey would drag and drop markers onto the Google map image of Kangaroo Island to identify places that they valued, where they would like to see future development and where they would not like to see future development (Figure 9).

The comparison between the 2004 and 2010 surveys showed that there was little change in “respondents’ opinions on development and tourism growth” and

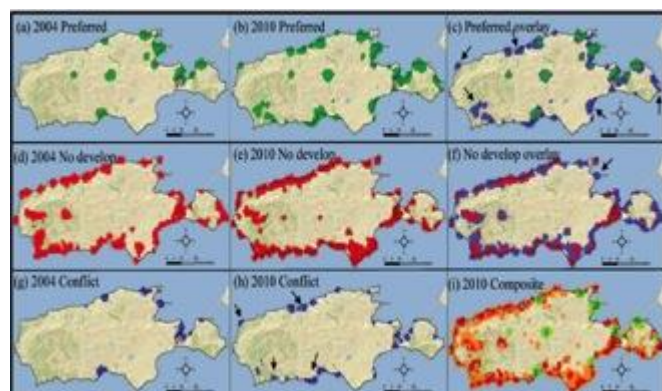


Figure 10: Respondent Opinions on Tourism Development in 2004 and 2010.

most believed that tourism will contribute to the economic prosperity of the island (Brown & Weber, 2012). The spatial results show that there has been a shift toward acceptance of tourism development in certain parts of the island and conflicting views in others. The opposition to development came from residents who wanted to protect specific places and areas that held some specific value (Brown & Weber, 2012).

The online survey had a relatively low response rate of 16.2% which when compared to other web-based PGIS studies this rate was higher than most studies who reported a rate of less than 10% (Brown & Weber, 2012). The researchers noted that there could be a participation bias when using an online tool towards those in higher income groups who have more access to the Internet, those who are computer literate, and would exclude participants who are 65 years and older with less formal education (Brown & Weber, 2012). Even with minimal response rate and a potential bias, the researchers concluded that using an online PGIS methodology is a cost-effective tool for tourism development, planning and monitoring.

3.5 Squam Lake, New Hampshire

In 2013, Veilleux used an online platform to analyze knowledge, concerns and behaviors of recreational users on Squam Lake, NH in order to provide guidance on how to incorporate public participation into management. Public participation is an aspect currently missing from recreation research on Squam and has been informed from expert opinions and biological data. Squam Lake provides diverse recreational opportunities such as motor boating, kayaking, sailing fishing, ice fishing, snowmobiling and cross country skiing. In recent years, there has been an increase in growth and popularity of the lake and all the activities it has to offer. The region is

managed by several agencies, is a part of three counties, five towns all with overlapping jurisdictions (Veilleux, 2013).

270 recreationists from random samples and targeted surveys of Squam Lake Association members participated in a survey that asked questions in order to gain more information about their perceptions and knowledge about the lake,



Figure 11: Hotspots of different recreational activities in Squam Lake, NH. These activities include boating, non-motor boating, fishing and swimming (Veilleux, Eisenhauer, & Brown, 2013).

concerns about recreation in the lake and spatial recreational patterns (Veilleux, 2013). The information was compiled and distributed to recreationists and managers so they could easily use the maps to learn more about the lake, specifically various hotspots found. For example, with a map of different recreational activities (Figure 11), recreationists could use the map to avoid areas that are highly crowded while managers could use that same information to properly address and manage those highly used areas. The results of the research project identified physical areas that are perceived by recreationists to be at risk, areas of concern, and what activities were present on the Lake and where. The specific methodology of The Public Participation GIS survey technique allowed the researchers to “spatially represent the perceptions and patterns of recreationists and obtain their input to help understand and address lake issues” (Veilleux, 2013).

3.6 Summary/Conclusions of Mapping Projects

These mapping projects collected data on tourism/recreation and applied them to management of the area but only analyzed one aspect of the BLT model – locals. Integrating brokers and tourists into mapping projects will make the analysis more robust and provide additional information that may have been missed with just data collected from locals. The projects have shown that there is a strong need to collect more spatial data that can be incorporated with biological/geological data. Recreation data is primarily lacking local knowledge and is typically based on expert knowledge or biological impacts to the region due to visitation. One major limitation is that each mapping project only represents one point in time and in order for it to be an effective measurement for tourism/tourist activity, temporal patterns and time series analysis need to also be done in order to see the changes occurring in the tourism system. Mapping projects have also shown low involvement/low response rates which may be attributed to the complexity of mapping, access to the Internet, education and age. Research should be conducted on how to effectively reach out to the public to show them the benefits of this type of data as well as to teach people on how to use mapping software. Maps created from the input of local residents and tourists provide more details to make a comprehensive map of the region and a visual way for any user to see.

PART II: A PGIS CASE STUDY OF HOOD CANAL, WASHINGTON

Part II provides a case study of PGIS in the Hood Canal of Washington State. It describes the study site and the specific methodology used to collect and analyze tourism-recreational data. The data collected is used to address the overarching research question about the extent and density of tourism-recreational activities. Once the results and analyses have been summarized and discussed, a list of recommendations on how to use this type of information is provided.

Chapter 4 – Study Site

4.1 Geographic and Biological Profile

4.1.1 Physical Description

Hood Canal is a saltwater fjord more than 60 miles long with 242 miles of shoreline that forms one of the four main basins of Puget Sound (Visit Kitsap Peninsula, 2014). Hood Canal is naturally formed by the melting of an ice sheet and is comprised of several internal bays and rivers that flow into it. Hood Canal is the western-most waterway in Washington State and is about 40 miles west of Seattle. It spans through Jefferson, Kitsap and Mason Counties as well as two tribal nations, Port Gamble S’Klallam Tribe and the Skokomish Tribal Nation (Hood Canal Coordinating Council (HCCC), n.d.) (Figure 12). Hood Canal begins in the north in Admiralty Inlet and extends southwest about 45 miles to the Great Bend near Union where it curves northeast 15 miles towards Belfair (HCCC n.d.). Similar to other basins, Hood Canal is isolated by a sill near its entrance which limits the transport of deep water in and out of Hood Canal (Gustafson et al., 2000). Tidal currents are slow with the strongest currents occurring near the entrance. Hood Canal ranges in depth from <40 meters in the Great Bend to 200 meters in the central region.

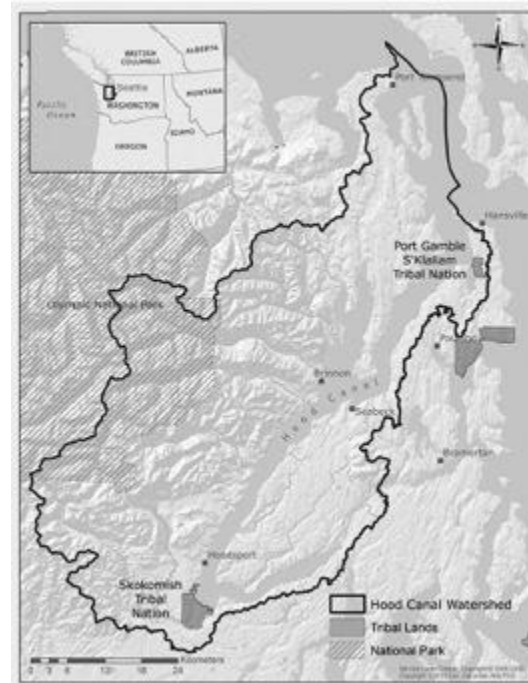


Figure 12: Boundary of Hood Canal, WA as defined by the Puget Sound Partnership. The action area encompasses both marine and terrestrial aspects of the region and is one of eight in the Puget Sound region (Biedenweg et al., 2014).

4.1.2. Climate

The climate in the Hood Canal region is influenced by both the Olympic Mountains as well as the bodies of water surrounding the Olympic Peninsula. The weather varies season to season and place to place with an overall moderate marine climate. At the southern end of the canal in the lowland area, the typical climate is a wet winter and dry summer (Footen, 2011). In the north, the Olympic Mountains create a rain shadow over portions of the basin. It is generally mild and temperate with the Pacific Ocean moderating temperatures throughout the year. In general, winters tend to be cool and rainy with some snow in the mountains and the summers tend to be pleasantly warm and relatively dry. Summers tend to have temperatures ranging between 65 and 75 degrees Fahrenheit while winters are mild at low elevations with temperatures in the 30s and 40s (Mason County Joint Tourism, 2013). July, August and September are the driest months and precipitation varies from 75 cm per year in the north to 255 cm per year at the Skokomish River, on average (Footen, 2011).

4.1.3 Flora and Fauna

The Hood Canal watershed is highly dependent on the cycling of clean water and nutrients to sustain its rich biological character. There are a variety of migrating species that use the Hood Canal as a migration corridor such as swallows, shorebirds, salmon, and smelt, and humans. The region also provides a unique habitat of intact forests found in and around the Olympic National Park, Forest and Wilderness Area (Puget Sound Partnership (PSP), n.d.). Hood Canal is home to a wide range of biological organisms from evergreen trees to salmon and provides scenery, homes and recreational opportunities to its residents and visitors. In the summer season, there is a significant increase in the number of people that visit the region (Hood Canal Dissolved Oxygen Program, n.d.).

Each year, levels of dissolved oxygen drop throughout the canal during the late summer and fall. Research has indicated that mobile bottom dwelling organisms tend to move upward in the water column to escape the low levels of dissolved oxygen. Organisms that are not mobile become stressed and die (Hood Canal Dissolved Oxygen Program, n.d.). In the fall of 2003, “rockfish were observed in the shallows and deep-water shrimp were skittering along the shoreline. Shortly afterwards great numbers of marine critters died because the entire water column was without oxygen”. Low dissolved oxygen occurs naturally but may be exacerbated by human activity.

4.1.4 Main Population Centers and People

The watershed is home to 71,391 people (Governor’s Salmon Recovery Office, 2012). The main cities in the region are Port Townsend, Hoodspport, Quilcene, Union, Belfair, Seabeck, Port Gamble, Brinnon, Holly, Eldon, Lilliwaup, Potlatch, and Tahuya. US route 101 runs along the west side of the Hood Canal. The Hood Canal Bridge is a floating bridge that connects the Kitsap and Olympic Peninsulas at the north end.

As part of a research study on human well-being indicators in the Hood Canal water, 36 attributes were identified based on literature review and interview data (Biedenweg et al., 2014). These attributes represent what matters to Hood Canal residents and how living in the area contributes to their well-being. These attributes included access to recreational opportunities, access to local food, industry such as commercial fishing, tourism and shellfishing, communication, outdoor exercise, restoration/therapeutic, strong communities, traditional resource practices and positive emotions. Out of the 26 attributes found, 7 were related to tourism and recreation: access to recreational opportunities, outdoor exercise, healthy diet, self-

actualization, positive emotions, access to natural resource extraction, and the economic value from the tourism industry.

4.2 Hood Canal as a Social-Ecological System

Hood Canal is a biologically diverse watershed that also supports a thriving economy based on the natural resources in the area. The Hood Canal watershed represents a coupled social-ecological system as humans depend on natural marine resources and the services that are provided by the ecosystem. Shellfish, salmon and forests support Hood Canal's tourism, recreational and commercial shellfishing, agriculture and lumber economies (HCCC n.d.). Residents also receive ecosystem benefits from hydropower supply, groundwater wells and plentiful opportunities for recreation and tourism (PSP n.d.). One main component of Hood Canal's economy is tourism and recreation since it is home to "more than 200 miles of protected shoreline and 40 square miles of shellfish-rich tidelands" (Mason County Joint Tourism, 2013). Hood Canal is advertised as a "prime attraction for all types of recreational fun" (Mason County Joint Tourism, 2014). Residents also are deeply invested in the area as they depend on the watershed economically, aesthetically and for recreation/tourism (Ramirez, 2008).

4.2.1 Tourism in Hood Canal

The tourism industry in Hood Canal is based on the ecological condition of the region. Excellent water quality is required to grow productive shellfish as well as provide habitat for salmon. Forestlands are an integral part of the landscape as well as provide a variety of health and well-being benefits to Hood Canal communities (HCCC n.d.). The preservation of the local ecological health as well as the social well-being of the surrounding area depends on proper

management. Tourism activities in Hood Canal occur in a variety of habitats and can be consumptive or non-consumptive. Including consumptive and non-consumptive activities ensures that all tourism/recreational activities are analyzed. Some examples of activities include skydiving, sailing, water skiing, birding, fishing, hiking, scuba diving, scenic viewing, wine tasting, boating and hunting. A longer list of recreational activities in Hood Canal is given in Appendix II.

In 2004, tourism metrics from an assessment showed that Jefferson County, Kitsap County, and Mason County earned \$28,700, \$57,000 and \$21, 500 from tourism respectively (Shelton-Mason County Chamber of Commerce, 2005). Tourism provided 1820 jobs in Jefferson County, 3100 jobs in Kitsap County and 1160 jobs in Mason County. Jefferson County collected \$2 million in local taxes while Kitsap County and Mason County each collected \$3.8 million and \$1.1 million, respectively.

Similar to other regions, there is minimal social spatial data available for Hood Canal, in particular on tourist activities. The Olympic Peninsula mapping project provides data on locals and values and activities associated with the region. Since the Hood Canal separates the Olympic Peninsula from the Kitsap Peninsula, this data only provides information about the western side of the Hood Canal watershed. Continuing research on the Olympic Peninsula has also collected visitor data from popular sites around the peninsula but this data would need to be sorted as some Hood Canal locals may have been classified as a visitor to those sites. These studies provide data on some residents of the region but there are other residents in the region who may not have been

able to participate through an in person workshop due to time constraints or ability to get to the workshop as well as not recreating in collection sites or having time to participate in the survey.

4.3 Hood Canal Coordinating Council

The Hood Canal Coordinating Council (HCCC) was established in 1985 in response to the community's concern over the environmental quality of Hood Canal (HCCC n.d.). HCCC is a watershed based council of governments that advocates and implements regional and local actions that protect and enhance the Hood Canal environment, natural resources and economic health. Currently, HCCC is putting together an integrated watershed management plan in order to provide a strategy in which to protect and restore the Hood Canal watershed (HCCC n.d.).

Workshops and community engagement activities involving stakeholders and the community were held in order to establish goals and select priority strategies (HCCC, 2013). The ultimate goal of the integrated watershed management plan is to provide a set of prioritized actions and strategies that will be implemented by the Hood Canal community. The Hood Canal community plays an important role in the implementation and success of the plan through their support to improve the environmental and economic well-being of the Hood Canal watershed. One of the focal components of the plan is recreation, which is defined as:

“A nature oriented recreational activity that includes both active and passive events that are enjoyed by both Hood Canal residents and tourists coming to visit, usually in pursuit of physical or emotional well-being. Examples of activities include fishing, touring, hiking, camping, bird and wildlife viewing, diving, swimming, boating, harvesting, etc. Recreation requires public access to recreation site” (HCCC 2013).

The focal component goals provide the “foundation and guidance for the development and implementation of strategies and actions for the Hood Canal watershed”. The focal components focus on important aspects of both the ecological and social systems that are relevant to the Hood

Canal community. Incorporating tourism/recreation spatial data into their management plan could provide HCCC with support from the public (both tourists and locals) about recreation/tourism actions and scientific basis for their actions/goals.

Chapter 5 – GIS Survey Methodology

The following hypotheses and questions were developed in order to answer an overarching question on what types of leisure activities are done in the Hood Canal region. These hypotheses hope to begin addressing the lack of spatial data available by providing data on leisure activities that brokers, locals and tourists can use. I hope that the data collected and analyzed will be useful for management decisions. Not only does the data provide information from the local community but also from non-locals who use the area.

5.1 Research Questions, Hypotheses and Predictions

This research examined the following research questions (RQ) and hypotheses (H):

RQ 1: What is the extent and density of recreational activities in Hood Canal?

H1. Certain areas are mapped more frequently than others.

RQ 2: Is there a distinction in activity locations between how tourists and residents use Hood Canal?

H1. Tourists have multiple different sites than locals where they participate in leisure activities.

H2. Locals visit recreational sites more frequently throughout the year but for a shorter amount of time than tourists.

RQ 3: How do the population subgroups perceive the impacts of their recreational activity on Hood Canal?

H1. Locals will perceive their activities to have a higher impact on the health of Hood Canal.

H2. People who participate in consumptive activities will state their activities have a higher impact on the ecosystem.

RQ 4: Does gender, age, or education level impact participation in online surveys?

H1. Gender, age and education are significant factors in who completes the online survey.

There will be a higher number of younger, well-educated female participants.

RQ 5: Is InSEAM an effective online tool to collect spatial data?

H1. InSEAM is an effective online tool for researchers

H2. Responses will be limited to highly educated users more familiar with mapping terminology.

5.2 Tool Development and Design

An online map and survey was created using the Natural Capital Project's InSEAM software. An online platform was chosen over printed maps/surveys in order to avoid the process of digitization as well as the potential ease and effectiveness of reaching out a wide range of participants. Emailing out a link would also allow for snowball sampling where original recipients of the email would pass along the email and link to obtain a larger sample size. InSEAM was specifically chosen because of its ease of storing data in GIS format as well as its ability to incorporate a variety of survey questions directly into the interface as opposed to setting up a different and independent online survey. In order to clearly represent the study area a GIS layer of the Puget Sound Partnership's Action Area of Hood Canal was added. This boundary was chosen because it is used by the Hood Canal Coordinating Council to define the

region's boundary. The online survey targeted residents of the three counties and two tribes that make up the Hood Canal region as well as any non-resident who have visited the Hood Canal region.

As soon as the link was accessed, a pop up window appeared and asked participants various demographic questions and perception questions about the health of the Hood Canal and the impact of their recreational activities (see Appendix II). The perception questions were developed based on Orams' (1997) five indicators that measured the effectiveness of an education program on tourists. These five indicators were enjoyment, knowledge, attitudes, intentions and responsible behavior. Simple attitude and knowledge questions were examined in order to see if tourists or locals were potentially more educated of how their behavior/activities impact the ecosystem. These questions were kept to a minimum as to not overwhelm study participants before the actual mapping part of the survey. The perception section will reflect personal attitudes of each participant on how they see their activities impacting the environment (See Appendix II).

On the actual map, participants were asked to draw using a point, line or polygon to signify the location of recreational activities. There was no limit to how big or long the shape must be as long as it encompasses the area the participant is trying to map. The participants were directed to designate up to three recreational activities that they do in Hood Canal with a maximum of three locations associated with each one of those activities. However, the software allowed each participant to mark more or less. The survey required the participant to list the activity associated with the area and why they value that location. There was no limit to how many locations or

activities a participant could map, but were requested to map the top three locations for each activity (up to three as well) (see Appendix I).

5.3 Data Collection

An opt-in survey was launched at the end of winter/early spring via targeted emails with subsequent snowball sampling (Appendix III). The email contained a consent form approved by University of Washington's Institutional Review Board and provided the linked to the map.

Individuals were requested to forward the original email to other individuals as well as organization list serves they may be a part of. For Hood Canal residents, emails were sent to individuals of Jefferson, Mason and Kitsap counties as well as Port Gamble S'Klallam Tribe and The Skokomish Tribal Nation. They represented organizations and agencies such as Mason County Public Health, Hood Canal Coordinating Council, visitor centers and tour operators, as well as retirees.

A list of potential participants was put together based on a previous list of stakeholder identified in human well-being research done in the area (Biedenweg et al., 2014). The names and emails were collected from county commissioners, HCCC representatives, county representatives, and active community members. For Hood Canal tourists, emails were sent out to individuals who reside in Olympia, Seattle, Tacoma, Edmonds as well as organizations such as the Department of Ecology, University of Washington, Microsoft, The Nature Conservancy, Rolluda Architects, Seattle School teachers and tour companies. The individuals and organizations were selected due to their representation of residents of Washington who participate in tourist activities as well as encompassing city centers surrounding the Hood Canal. Participation in this study was voluntary

and there was no penalty if someone did not participate or withdrew while taking the survey. The online survey could take a participant anywhere from 15 minutes to 45 minutes to complete.

The map was open for a month long period with one reminder email being sent out towards the end of the month. Any data entry that did not contain the zip code of the primary residence or a list activity associated with their map was discarded. Each participant needed to input the zip code of their primary residence in order to separate the participants into two distinct user groups (see Appendix I). Zip codes associated with cities that border the Hood Canal Region were identified so as to categorize participants into locals or tourists subgroup. Those zip codes are 98312, 98315, 98320, 98325, 98339, 98340, 98346, 98358, 98365, 98367, 98368, 98370, 98376, 98380, 98393, 98524, 98528, 98548, 98555, 98584, 98588 and 98592. Any zip code not listed previously was grouped as Hood Canal tourists. Since the respondent had to manually enter the type of recreational activity, it was re-coded as described below and re-labelled for uniformity across all data points for the analysis. All text data was reclassified using ArcMap 10.2 into categorical variables in order to run analyses and a metadata table was created (See Appendix IV). All data, including IP addresses, were maintained on a secure Stanford University's server accessible only to the principal researcher.

Activities were first recoded for uniformity which meant that all the same activity had to be capitalized and spelled the same way for ArcGIS to count it as the same activity. For example, two respondents listed 'Beach Combing' and 'beachcombing' as their activity which had to be recoded into 'Beach Combing'. Canoeing and kayaking and any form of shellfishing were relabeled as canoeing/kayaking and shellfishing to be consistent across all data entries. All the

data in the attitude table was stored as text data and was converted into an integer field using ArcGIS.

For analysis purposes, activities were then coded into seven larger categories based on groupings created by the Oregon recreation study and the Olympic Peninsula mapping project. The seven categories were non-motorized land/shore activities, non-motorized water activities, motorized water activities, touring/sight-seeing, fishing/shellfishing, stewardship/scenic enjoyment and wildlife viewing. Fishing/shellfishing was a separate category from either water activities because it was unclear if the activity was conducted by motorized or non-motorized transportation. Table 1 provides a summary list of all activities listed under each category and appendix VII provides a detailed list of all activities listed.

ACTIVITIES for analyses (7)	Included Activities:
Non-Motorized Land/Shore Recreation	Backpacking
	Beach Combing
	Beach or Nature Walking
	Biking
	Camping
	Easy Nature Trails/Walks
	Hiking
	Plant/Fungi Foraging
Non-Motorized Water Recreation	Boarding
	Kayaking/Canoeing
	Sailing
	Swimming
	Scuba Diving
	Wind Surfing
Motorized Water Recreation	Boating
Touring/Sight Seeing	Visiting Whitney Gardens
	Touring
	Visit Port Townsend
Fishing/Shellfishing	Clamming
	Crabbing
	Fishing
	Oyster Collecting
	Shellfishing

	Shrimping
Stewardship/Scenic Enjoyment	Salmon Stream Restoration
	Photography
	Picnicking
	Relaxation
	Nature Appreciation
Wildlife Viewing	Wildlife Viewing
	Whale Watching
	Bird Watching

Table 1: List of activities that fell under each of the 7 categories.

The opt-in nature of the study may have skewed results such that certain demographic groups may be underrepresented and thus the density and extent of activities may not be representative. I explored this by comparing response demographics to Hood Canal demographics through US Census data. As a result, the study findings are only a summary of those who chose to participate in the online survey format. A limitation of the data collection was that the map itself required a participant to input information as GIS components and people may have been unfamiliar with GIS jargon. This may have ultimately detracted people from mapping more than one location or attracted respondents who were familiar with GIS.

5.4 Data Analysis Using ArcMap 10.2 and Microsoft Excel

Once the survey was closed to responses, the data were aggregated into ArcGIS 10.2 to create spatial maps and define attributes. Attribute tables for each shapefile were exported and combined into one Excel spreadsheet.

In ArcMap 10.2, geospatial analyses were used to visualize any differences between the maps of locals and tourists. Based on analysis methods from the Olympia Peninsula Mapping Project, density of activities was calculated by spatially joining each shapefile to a quarter-mile fishnet

grid which was created (McLain et al., 2013). This was done for all activities, by population subgroup and the top two activity categories.

Density mapping and hotspot analyses were conducted to explore the density of recreation areas. The density maps indicate the number of times a location was mapped (ESRI, 2013; McLain et al., 2013). This was produced by creating a quarter mile buffer around the point and line shapefile. These were then merged with the polygon shapefile to create an aggregated shapefile. Then, the aggregated polygon shapefile was spatially joined to a quarter mile grid cell to create join counts for each cell. This grid cell resulted in 21,760 points that were re-symbolized with color graduations to represent areas that were mapped most frequently (darker colors) and less frequently (lighter colors). Hot spot analysis “identifies statistically significant hot spots and cold spots using the Getis-Ord G_i^* statistic” (ESRI, 2013). It isolates hot (high values) or cold (low values) spots of values across a landscape. It shows whether the observed clustering of high and low values is more pronounced than one would expect in a random distribution of those same values (or under the null hypothesis where the Hood Canal is mapped equally). These analyses were run on the overall aggregated data, for each subgroup (tourists and locals) and on each category activities.

Pearson’s χ^2 test was run in Microsoft Excel 2010 to check for any significant associations between the subgroups and perception, as a whole and by each activity category, as well as across demographic variables such as gender, education level and frequency of stay. A two-tailed t-test was run using Excel 2010 to test for differences between age and years visiting the Hood Canal.

Chapter 6 – Results

This chapter provides the result for each research question through visual representations of the activities and a summary of the sample size, demographic data and perception questions.

Interpretation of the results can be found in the following section.

RQ 1: What is the extent and density of recreational activities in Hood Canal?

A total of 41 individuals participated, and described a total of 162 activities.

The least a person mapped was 1 one activity site and the most was 12.

Females marked 95 activities while males only marked 61 activities. There was 1 respondent who did not list a gender and accounted for the other 6 mapped activities. Females, on average

mapped 4.27 activity sites (range = 1 to 12) while males mapped 3.75 sites, on average (range = 1 to 10). There was no significant difference found between how many sites females mapped versus males. Overall, the top three categories were non-motorized land/shore, fishing/shellfishing and non-motorized water activities (Figure 13). Males and females had the same top 5 categories, but males mapped more stewardship/scenic enjoyment activities than motorized water activities.

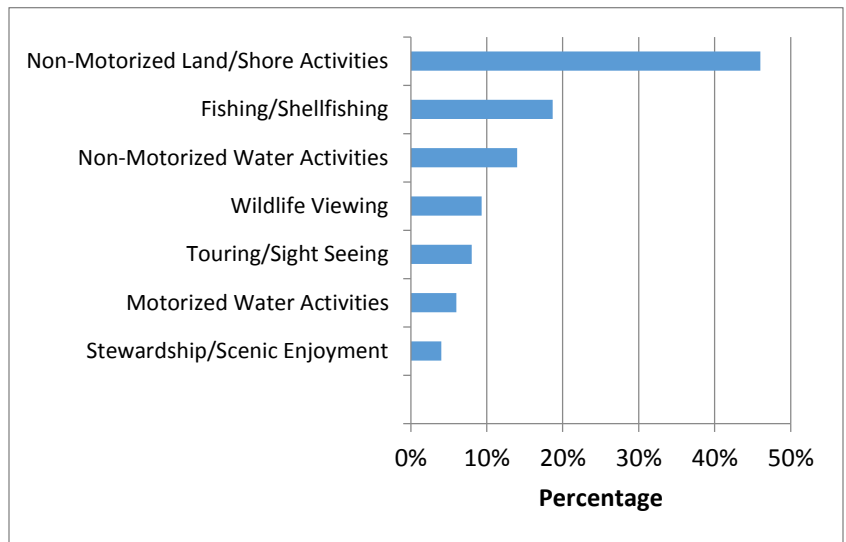


Figure 13: Percentages of All Activities in the 7 activity categories.

More specifically, the top three overall listed activities were hiking, shellfishing, and camping representing 18%, 15% and 8% of the activities (Table 2). The activities differed between males and

Activity	Percentage	Females	Males
Hiking	18%	18%	16%
Shellfishing	15%	12%	18%
Camping	8%	9%	7%
Touring/Sightseeing	7%	7%	7%
Bird Watching	6%	4%	8%
Boating	6%	6%	3%
Canoeing/Kayaking	5%	4%	7%
Fishing	5%	4%	5%
Swimming	5%	4%	5%
Beach Combing	5%	4%	7%

Table 2: Top 10 mapped activities for all respondents.

females. Females included walking in their top 10 activities, which is not seen in the big picture, and mapped more boating activities. Males had shellfishing as their number one mapped activity as opposed to hiking. Males also mapped, beach combing, canoeing/kayaking and bird watching more often.

Figure 14 shows the aggregate of all participant-mapped recreation areas based on the seven activity categories. Participants drew 89 points and were equally spread amongst tourists (n=49) and locals

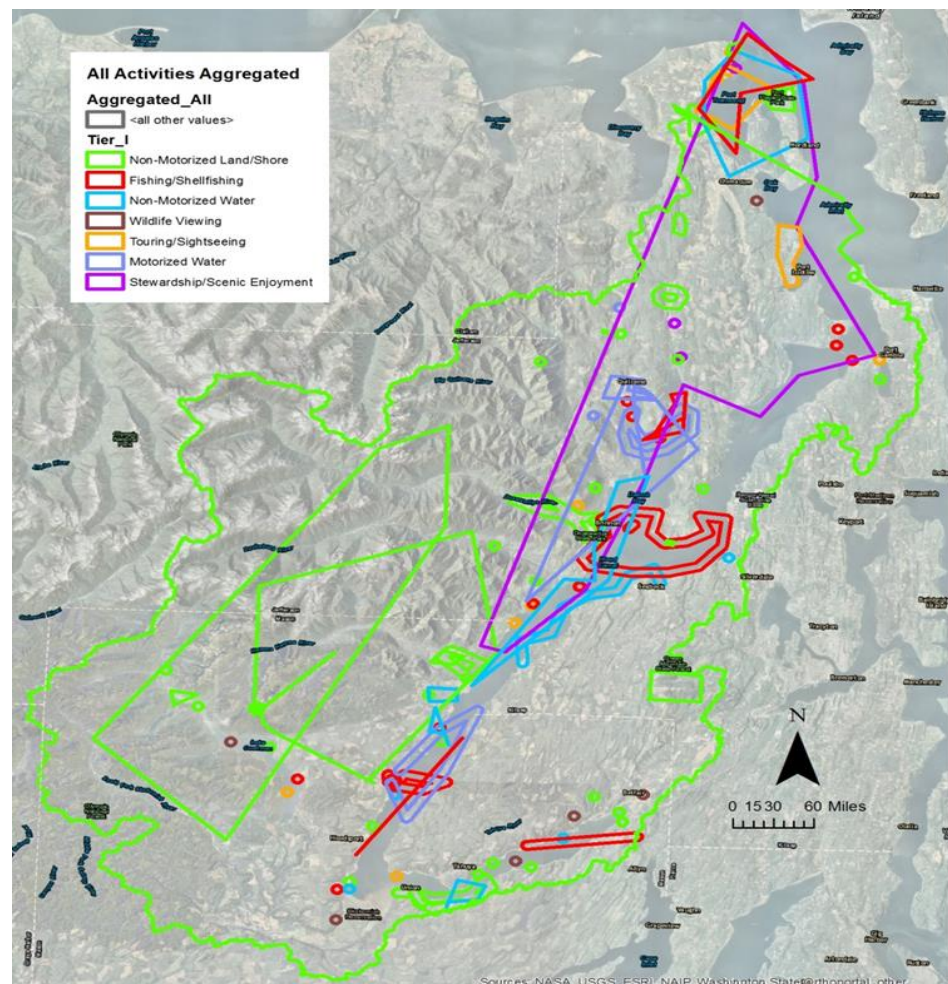


Figure 14: Aggregated layer of polygons, lines and points showing all mapped activity sites and color coded by category (n= 162 activity sites).

(n=40). There were 49 total polygons and locals drew 27 of them while tourists drew 22. Very few participants choose to draw lines to represent their activities (n= 21) with tourists drawing over 50% of the lines. Points and polygons represented all seven activity categories whereas lines only represented five: fishing/shellfishing, motorized water activities, non-motorized land/shore activities, non-motorized water activities, and wildlife viewing.

Density maps created ~21,000 grid cells and showed that activities were mapped more often and therefore were largely concentrated along the central region of Hood Canal, in the north around Port Townsend and Port Ludlow as well as small concentrations near the Great Bend (Figure 15). Hotspot analysis revealed a similar pattern, but also identified a hotspot in the Olympic National

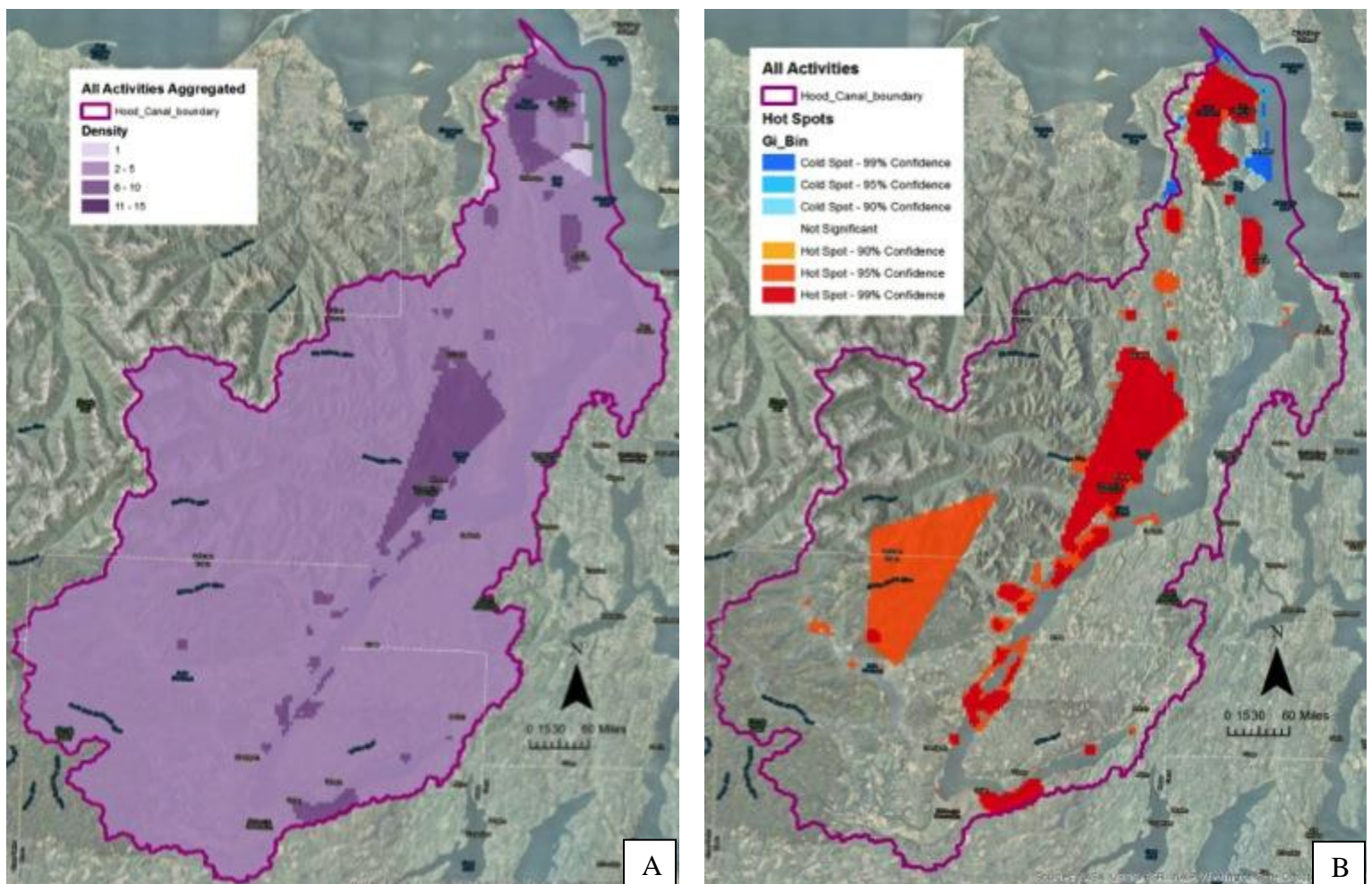


Figure 15: Density mapping (A) and hotspot analysis (B). The darker purple spots in A represent areas that were mapped more frequently. The orange/red regions represent statistically significant hotspots which means that the high spatial clustering is more pronounced than one would expect in a random distribution of those same values (or under the null hypothesis). The blue cold spots represent statistically significant low spatial clustering.

Forest and in Lake Cushman that wasn't revealed through the density map. Significant cold spots (shown in blue) were found in the southern part of Marrowstone and in the northern part of the canal around Admiralty Inlet.

The different patterns found within the categories help explain the overall observed density and hotspots. Non-motorized shore and land activities were mapped throughout the watershed. There were higher concentrations of non-motorized shore/land activities in the Olympic National Forest, State Parks such as Old Port Townsend and Dosewallip, Port Ludlow and Union. Fishing and shellfishing activities were mainly distributed along the central and southern parts of the canal with concentrations across Seabeck and Brinnon, Dabob Bay, along Lilliwaup to Hoodspout and near Lynch Cove. Non-motorized water activities were concentrated in the central region spanning from Quilcene Bay down to Lilliwaup as well as the north around Port Townsend Bay and in the southern parts near Union and Tahuya. Figure 15 and 16 show that, as hypothesized, certain areas are used more than others and differ between the categories as well.

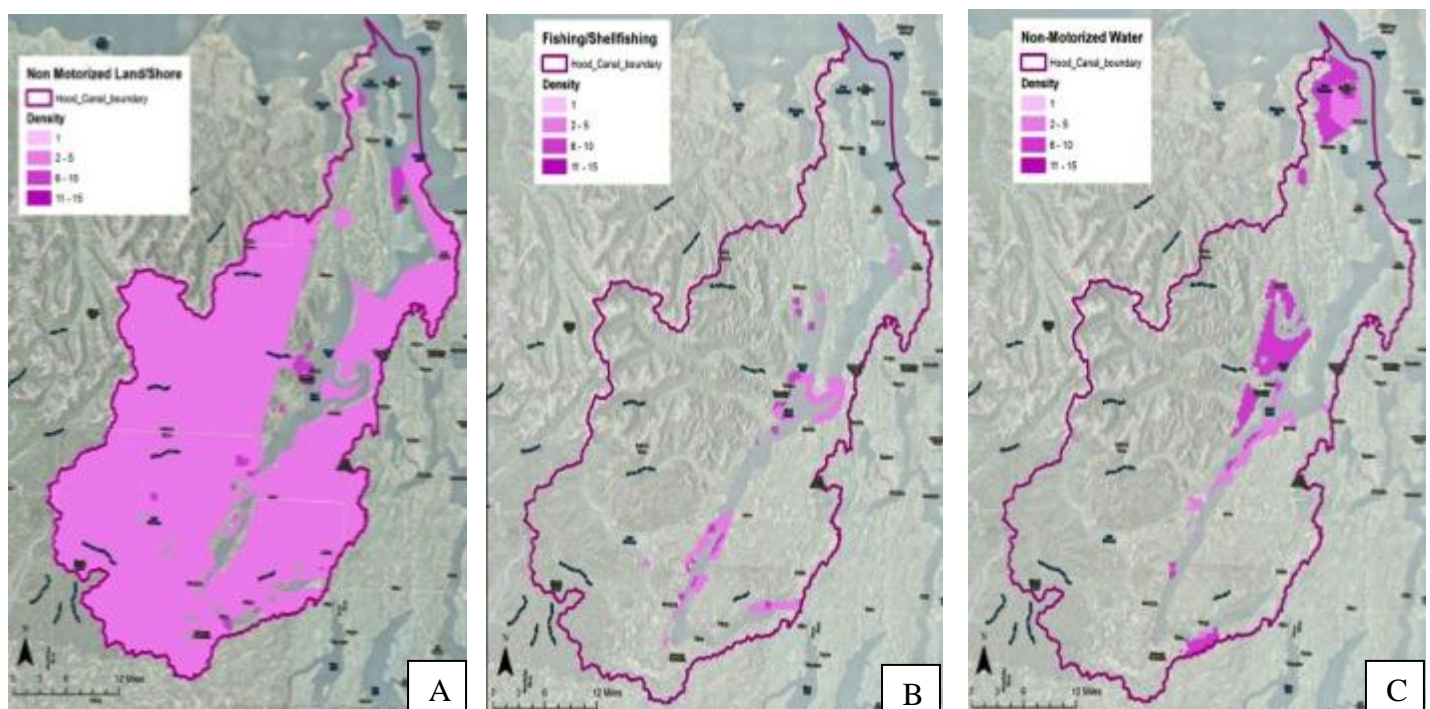


Figure 16: Density maps representing concentrations of mapped activity sites of non-motorized land/shore activities (n=69), fishing and shellfishing (n=30) and non-motorized water activities (n=21). Darker colors represent areas that were mapped with higher frequencies (A =16603 grid cells; B=640 grid cells; C = 11604 grid cells)

RQ 2: Is there a distinction in activity locations between tourists and locals?

Out of the total 41 respondents, 21 were locals and 20 tourists. The majority of respondents came from King, Jefferson and Mason Counties (Appendix VI). Tourists mapped a total of 83 activity sites and locals mapped 79. On average, tourists and locals mapped 4.3 and 4 activity sites, respectively ($p\text{-value} > 0.05$). Tourists ranged from mapping 1 to 9 sites while locals ranged from 1 to 12.

Tourist versus Local Activities:

As hypothesized, the top three categories were mapped with different frequencies for the two groups. Although both subgroups mapped non-motorized activities most often, tourists mapped shellfishing and fishing second and non-motorized water activities third whereas locals mapped those two categories equally. Non-motorized land and shore activities accounted for 50% of all mapped activities for locals whereas tourists marked them at 37%.

The top five activities for locals were hiking, shellfishing, beach combing, bird watching, and boating (Figure 17). Similar to locals, tourists had the same top 2 activities; however shellfishing and hiking were equally mapped. Unlike

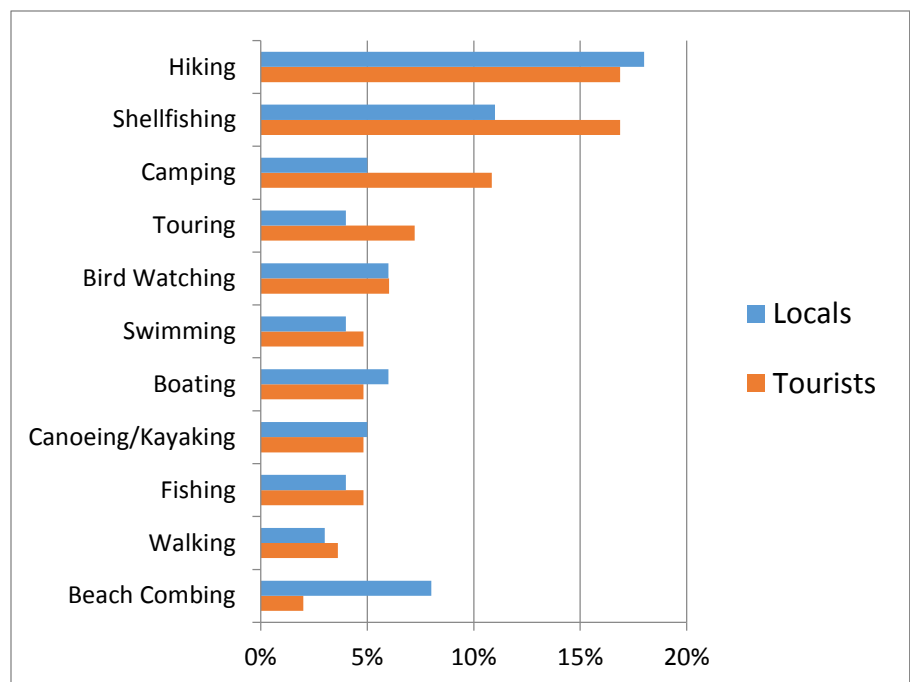


Figure 17: Percentage of the top eleven mapped activities for locals (blue) and tourists (orange).

locals, tourists' top five included camping, and touring, and followed last with bird watching (Figure 17).

Looking at the densities of all activities, it was evident that tourists mapped the whole watershed in higher proportion (Figure 18). Tourists mapped activities across the Hood Canal with medium frequency, creating only a few highly concentrated areas seen between Union and Tahuya, Port Hadlock, around Lilliwaup (on both sides of the canal), Hoodsport, and state parks around Port Townsend. Locals, on the other hand, mapped fewer locations but some with higher concentrations seen in the Olympic National Forest, Quilcene, Dabob Bay and Dosewallip State Park, Gibbs Lake Park, Port Townsend, and Fort Flagler.

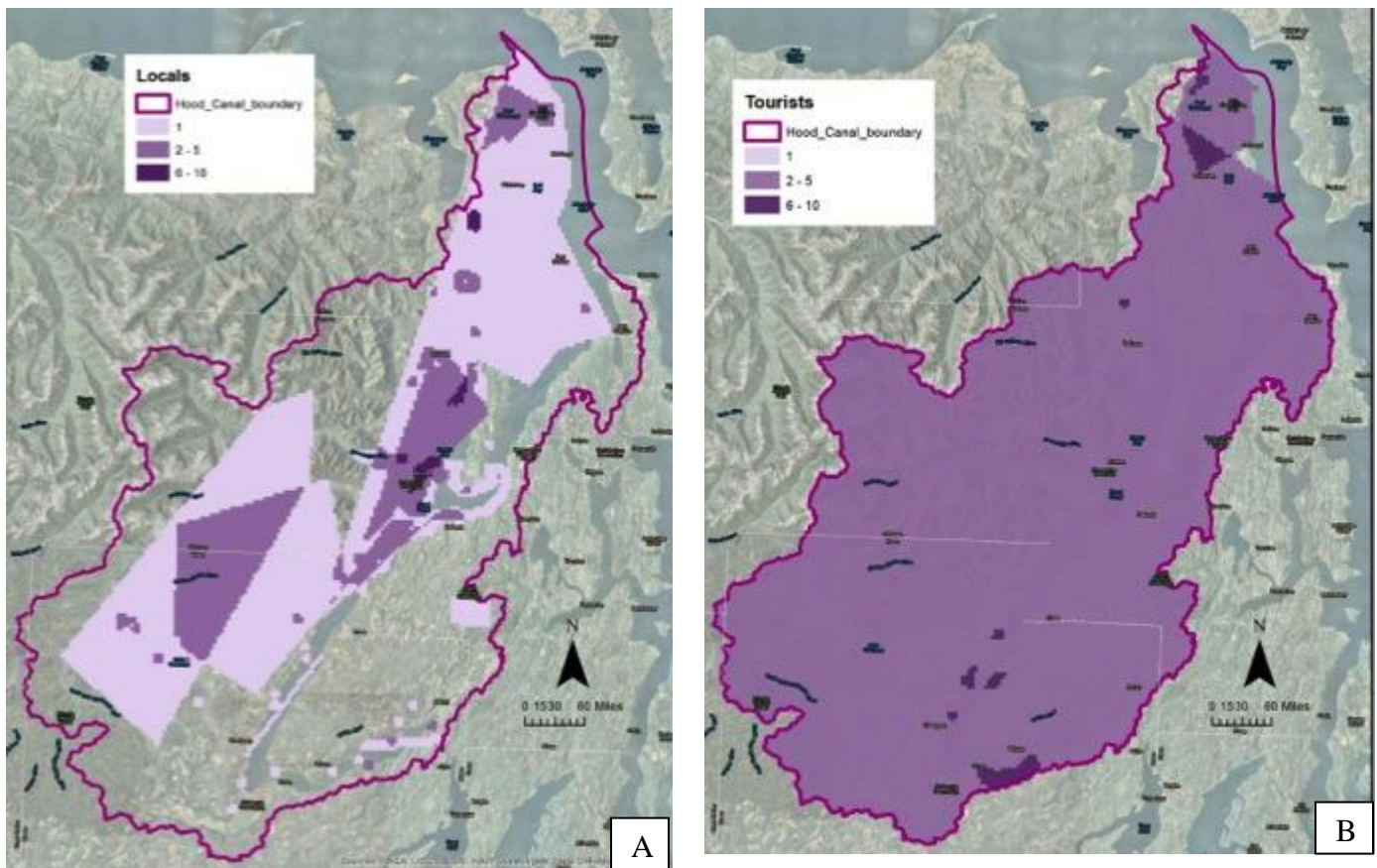


Figure 18: Density maps of all mapped activity sites for locals (A) and tourists (B).

Hotspot analysis on all activities demonstrated that the differences seen in the density maps are also significant (Figure 19). Even though the tourist density map revealed higher mapping concentrations around all of the Hood Canal water, hot spot analysis revealed that it was not significant. Tourists had a lot of scattered hotspots around the canal with larger hotspots found near Port Hadlock and Port Townsend and Port Ludlow and between east of Union. There were cold spots found along the northern tip of the watershed. For locals, there was one major hotspot discovered around Dabob Bay on the central west side of the canal as well as a small hotspot near Fort Flagler State Park.

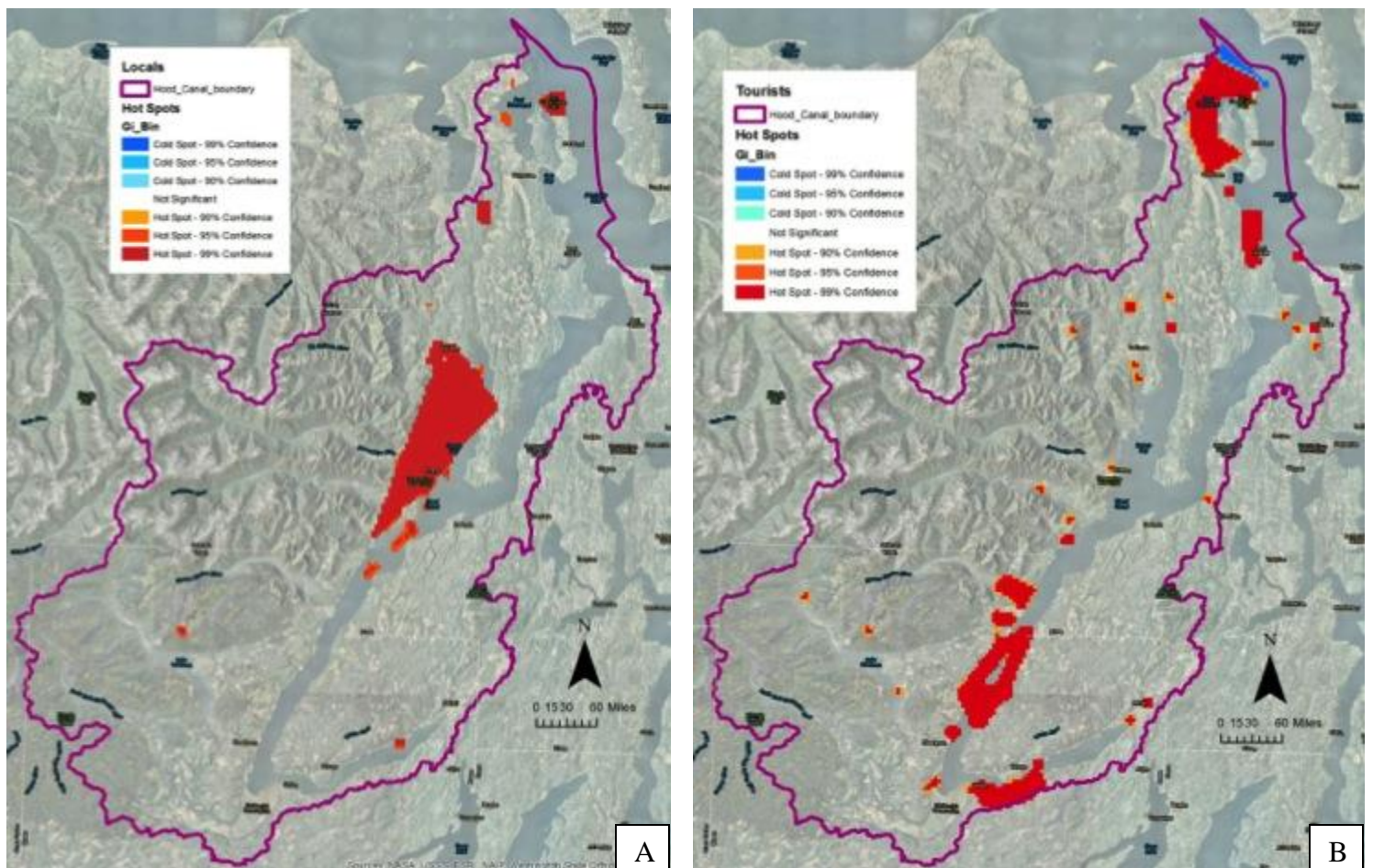


Figure 19: Hotspot analysis on observed spatial clustering for all activities for locals (A) and tourists (B). Red regions represent significant hot spots while blue regions represent significant cold spots.

Interestingly, when looking at non-motorized water activities, there were two distinct regions where locals and tourists went. Tourists had two significant hotspots up in Port Townsend and down in Union whereas locals had one large hotspot in the central region around Dabob Bay and Dosewallip State Park and then around Lilliwaup and Gibbs Lake (Figure 20).

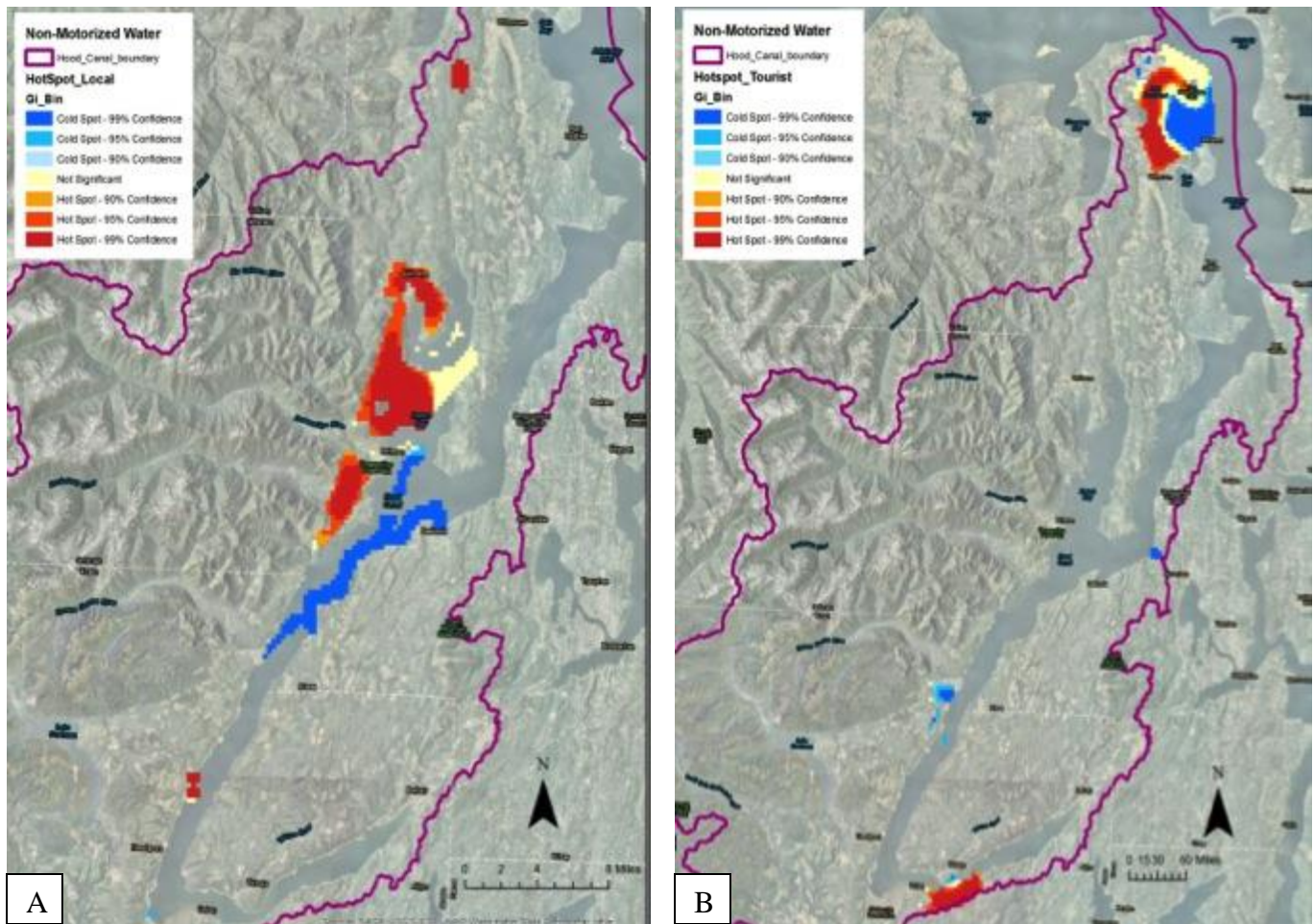


Figure 20: Hotspot analysis of mapped non-motorized water activity sites for locals (A) and tourists (B). Pale yellow represents mapped regions that were not significant.

Frequency of Activities:

When asked about the frequency of tourism/recreational activities throughout the year, 90% of locals recreated in Hood Canal more than 4 times a year (p-value = 0.006 and $\chi^2 = 12.52$). On the other hand, tourist's frequency was bimodal: either once a year or more than 5 times a year (Figure 21). However, the χ^2 test revealed that tourists participate in these activities 1-3 times a year more than expected. Tourists participate in recreational activities less frequently than locals.

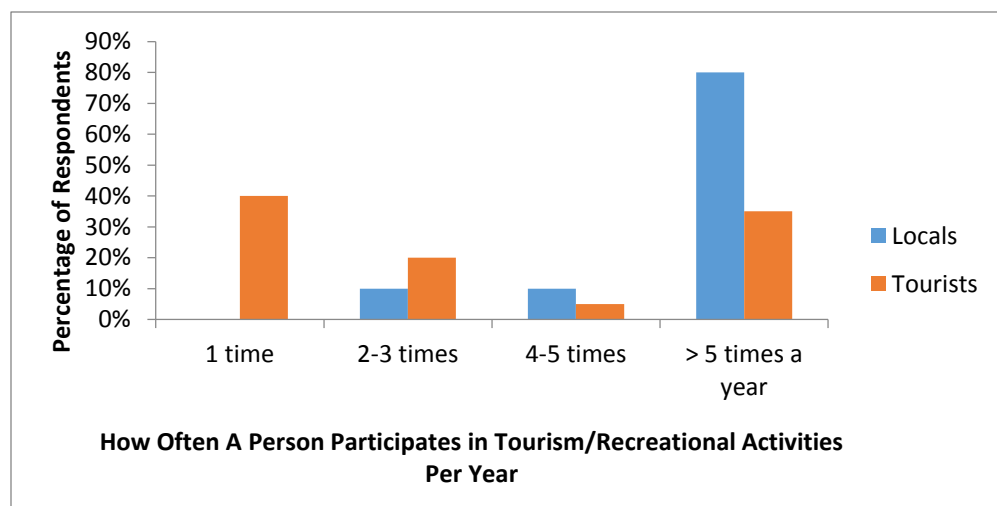


Figure 21: Frequency of leisure activities.

The most typical recreational stay for both locals and tourists was one day. 70% of locals reported that they stayed for a day for their recreational activity in Hood Canal while 58%

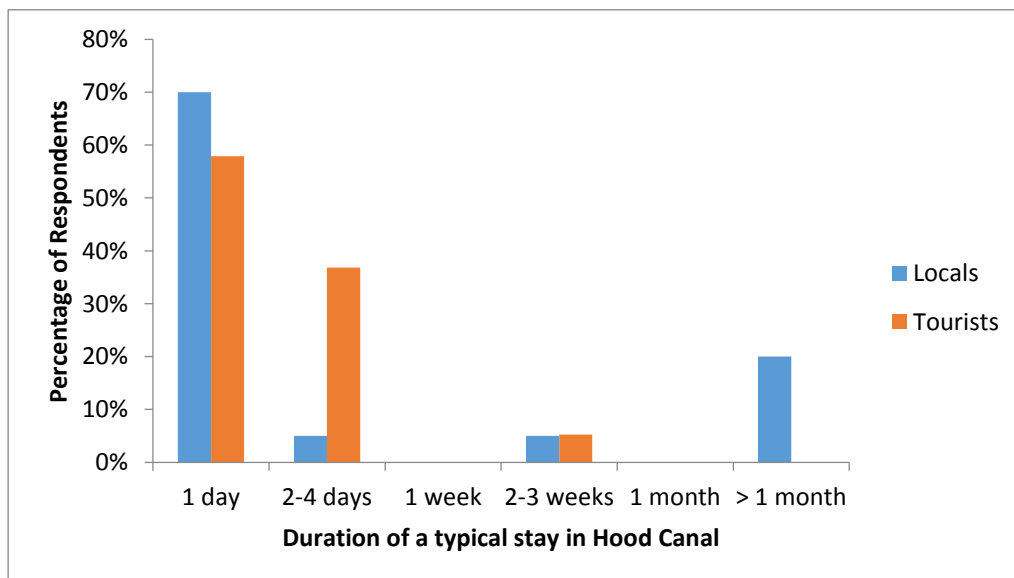


Figure 22: Duration of a typical stay.

tourists did the same. 37% of tourists also reported that they stayed somewhere between 2 – 4 days during a typical stay (Figure 22). There was a significant association between the subgroup and the duration of their stay, with locals staying for one day or greater than month more than expected and tourists staying for 2-4 days and 2-3 weeks more than expected (p-value = 0.03 and $\chi^2 = 8.84$).

RQ 3: How do the population subgroups perceive the impacts of their recreational activity on Hood Canal?

The survey assessed participant opinions about the health of Hood Canal and the impacts of their activities and the community's activities on that health. Respondents ranked their opinion on how healthy they felt the Hood Canal on a scale of 1 (unhealthy) to 5 (healthy). No respondent stated that the Hood Canal was unhealthy or slightly unhealthy. 20% of the tourist group indicated that it was healthy, whereas no locals stated the same (Figure 23). Most indicated that the Hood Canal's status was just ok/neither healthy nor unhealthy (p-value 0.09).

Half of both locals and tourists (48% and 50%) felt neutral about the statement on how the community's activities affect Hood Canal. 5% of both tourists and locals strongly agreed that the community's activities have an impact. Overall, more locals agreed with the statement than disagreed. Tourists were equally split with agreeing or disagreeing with the impacts the community's activities has on the Hood Canal. However, there was no significant difference between observed and expected values when comparing agreement to the statement and population subgroup.

In reference to the impact of their individual activities on the status of the Hood Canal the majority of participants disagreed that their activities impact the overall health of the Hood Canal. 81% of locals disagreed with the statement that their activities impact the state of Hood Canal and 70% of tourists also disagreed with that statement. 20% of tourists agreed or strongly agreed that their activities have an impact on the Hood Canal, whereas only 5% of locals agreed. 10% and 14% of tourists and locals, respectively, stated that they neither disagreed nor agreed

with that statement. However, a χ^2 analysis revealed no significant difference between observed and expected values when comparing agreement to the statement and population subgroup.

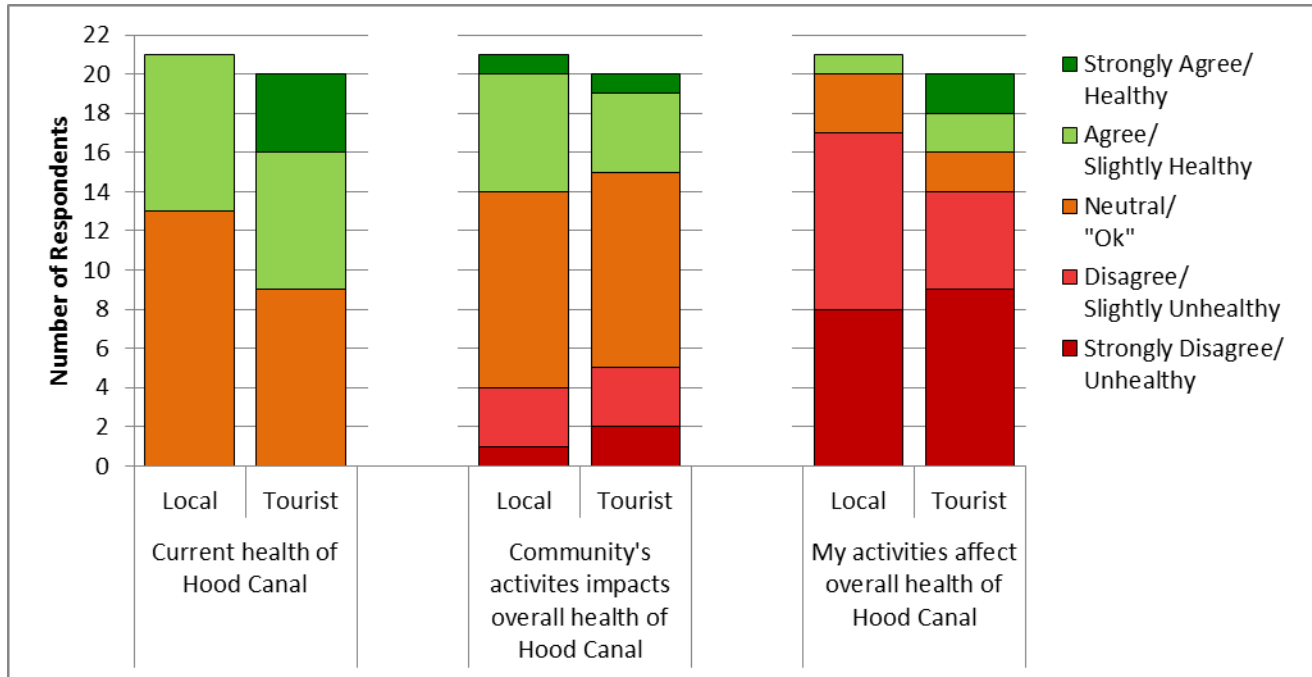


Figure 23: Summary of responses to perception questions about the health of Hood Canal and impact recreational activities have on that health.

When taking into consideration the different categories and in general, if respondents agreed or disagreed with the statement “my activities affect the overall health of Hood Canal”, a χ^2 test revealed there was a significant association between the two ($p\text{-value} = 5.65E^{-2}$; $\chi^2 = 12.25$). People who mapped non-motorized water activities, wildlife viewing, touring, and stewardship/scenic enjoyment activities were more likely to agree than expected with the statement that their activities impacted the watershed (Figure 24). While people who mapped non-motorized shore/land activities, fishing/shellfishing, and motorized water activities disagreed more than expected. People who mapped fishing/shellfishing activities and motorized water activities disagreed more than expected because no respondent stated that they agreed with

the statement. The same results were found within tourists ($p\text{-value} = 8.76\text{E}^{-2}$; $\chi^2 = 11.03$), while only locals who mapped non-motorized water activities were found to agree more than expected and disagreed more than expected for every other category ($p\text{-value} = 4.59\text{E}^{-1}$; $\chi^2 = 5.67$).

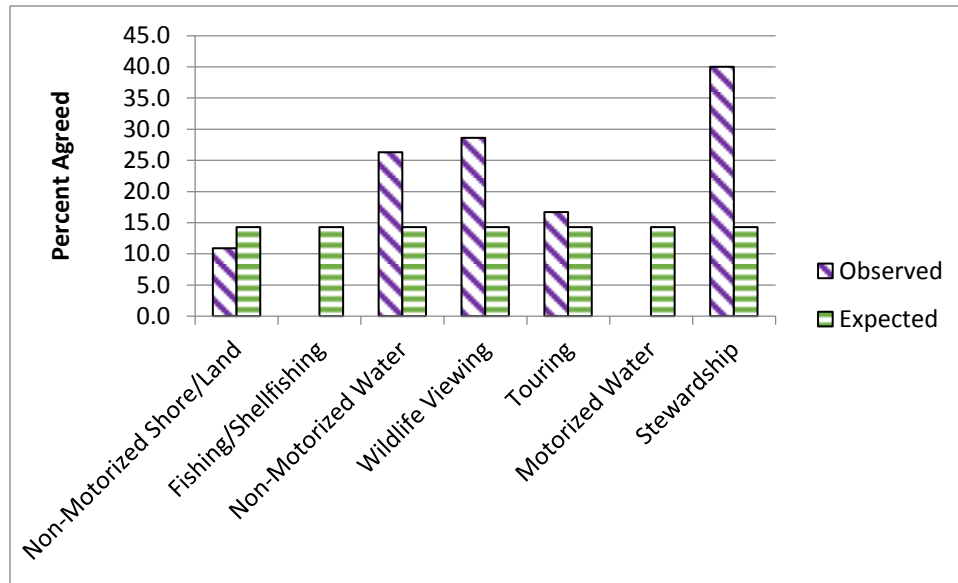


Figure 24: Observed and expected percentages of respondents who agreed with the statement that their activity impacts the health of the Hood Canal, sorted by the seven categories. There were no observed values for fishing/shellfishing and motorized water activities because no respondent stated that they agreed with that statement.

Looking more deeply at these perspectives by subgroup and activity categories it is shown that in four out of the seven categories, only tourists strongly agreed that their activities affected Hood Canal (Figure 24). Only in non-motorized water activities did locals state that their activities impact the watershed. There was no significant difference between tourists and local's perceptions about the impact wildlife viewing, stewardship/scenic enjoyment, touring/sightseeing, motorized water activities, fishing/shellfishing and non-motorized water activities had on the health of Hood Canal. There was a significant difference seen in non-motorized shore/land activities ($p\text{-value} = 0.007$). Tourist strongly disagreed more than expected while locals disagreed and felt neutral about their activity impacting Hood Canal.

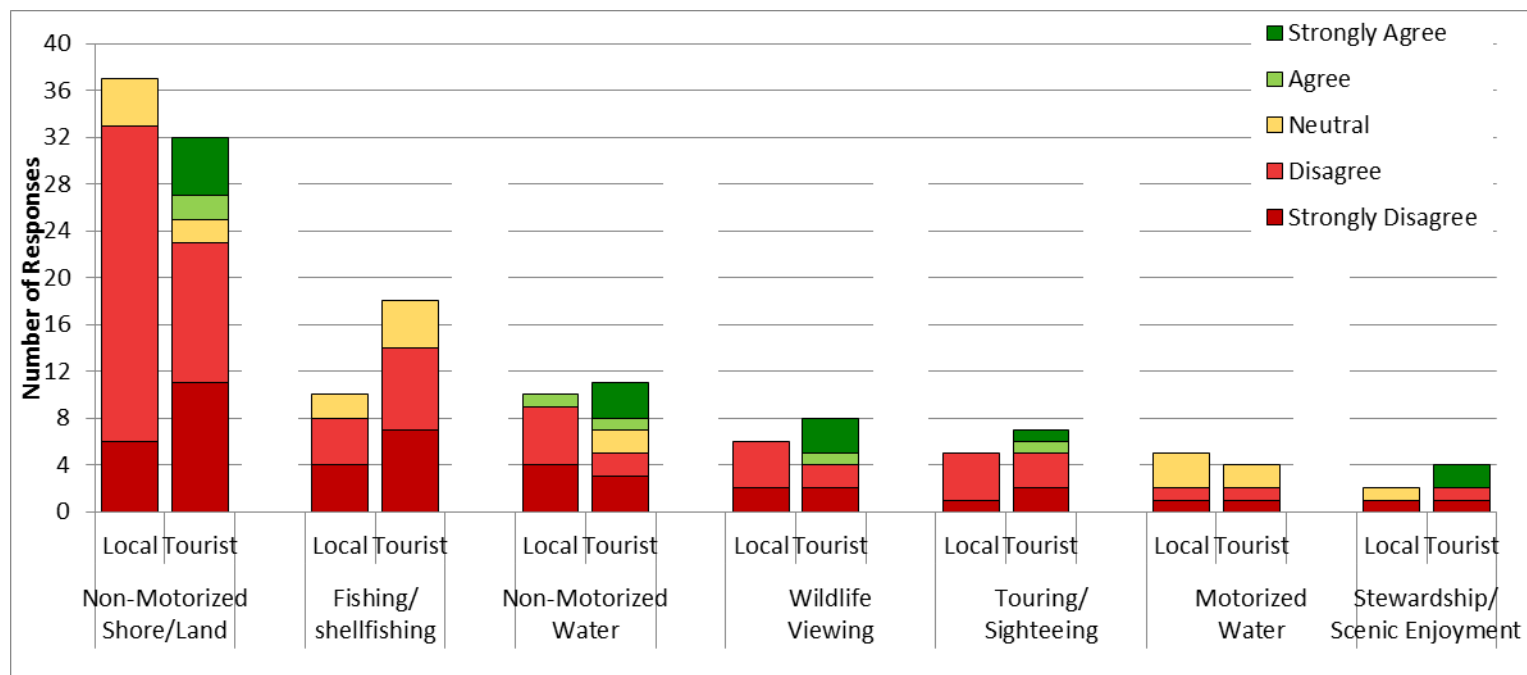


Figure 25: Response to activity impacts question divided by the seven categories..

RQ 4: Does gender, age, or education level impact participation in online surveys?

Overall, 55% of the respondents were females and 45% were males. Within the tourist group, more females participated in the survey than males while in the local group there were more males who responded than females (Table 3). There was no significant difference between gender and subgroup (p-value = 0.2).

	Locals	Tourists
Total Count	21	20
Total Females	45%	65%
Total Males	55%	35%
Average Age	55	44

Table 3: Summary of respondent's stated gender.

The average age for locals and tourists was 54 and 44, respectively (Figure 26). The range for locals was 31 to 89 years old and a median age of 51. Tourists ranged in age from 20-69 and had a median age of 38. There was a significant difference in age between the local population and tourist population (p-value=0.021, standard error = 3.34 for locals and 3.59 for tourists). Locals were on average, 11 years older than tourists. There was a higher proportion of local's

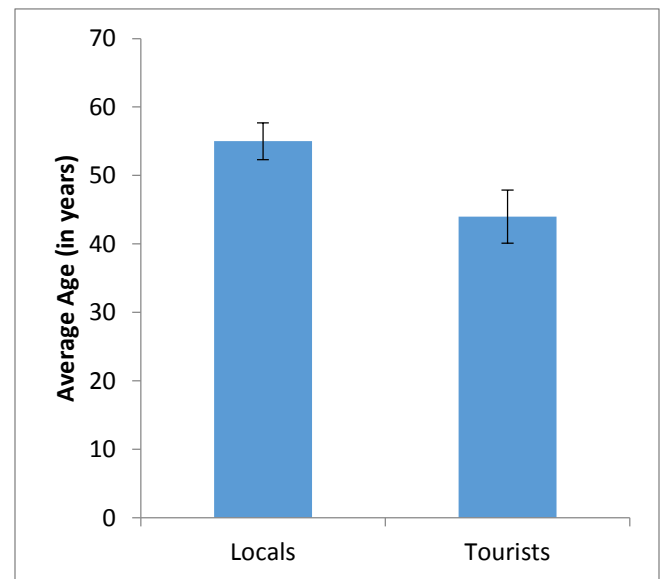


Figure 26: Difference in age between locals and tourists.

who were in the age groups of 35-54 and 65+ year old than expected and a higher proportion of tourists who were in the age groups of 20-34 and 55-64 than expected ($\chi^2=12.61$ and p-value = 0.027).

Age Group:	18-24	25-34	35-44	45-54	55-64	65+
Locals	0	1	6	5	2	7
Tourists	1	7	4	1	5	2

Table 4: Summary age groups of respondents

Survey respondents were also asked how long they have been visiting the Hood Canal. The mean and median number of years visiting for locals was 30 and 28, respectively and 20 for tourists (p-value = 0.02, standard error = 3.043 for locals and 3.035, range was 9-67 years for locals and 1-44 years for tourists). On average, locals had been visiting the Hood Canal region 10 years more than tourists. 50% of tourists have been visiting the Hood Canal region for more than 20 years. Locals, on average, have been living in Hood Canal for 20 years, and have been visiting the region for 30 years.

Regarding the level of education, most of the respondents indicated that they had some form of higher education; with 49% of all respondents indicating they had some graduate degree. No respondent had less than high school education. Of the tourists, 5% had high school diploma, 25% had a bachelor's degree and 70% had a graduate degree. Within the locals, there was more variation in education and most people had a bachelor's degree (Figure 27). There was a significant difference between education level and subgroup (χ^2 p-value = 0.04). In the local subgroup, there was a higher percentage of respondents with high school diplomas, bachelor's and associate degree than expected while in the tourist subgroup, there was a higher percentage

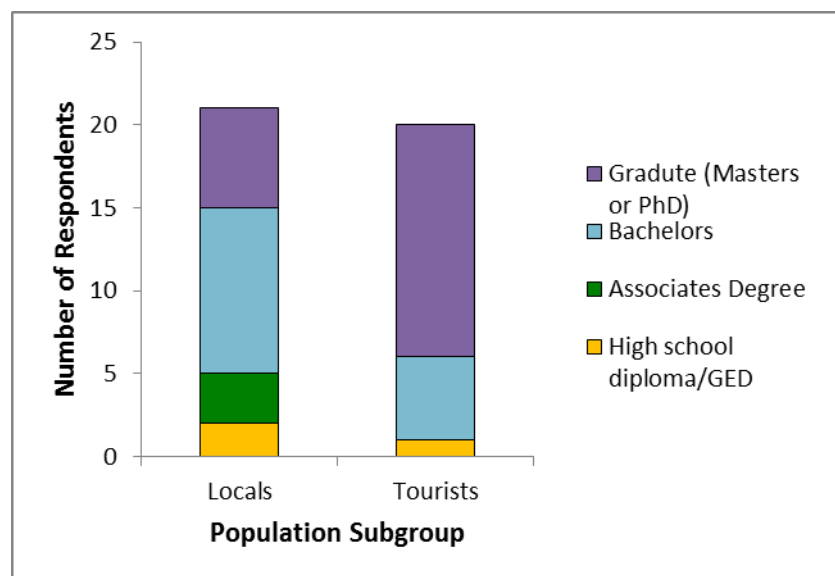


Figure 27: Education level in each subgroup.

of respondent's with graduate degrees.

Overall, survey respondents ranged in age from 20 to 89 years old, were more likely to have bachelor's degrees or graduate degrees and have been visiting the Hood Canal for an average of 25 years.

RQ 5: Is InSEAM an effective online tool to collect spatial data?

This question will be answered in the discussion section. A response rate could not be calculated because it was not possible to determine the amount of people who received the survey link due to the nature of snowball sampling. No significant difference was found between the area of polygons drawn between locals and tourists for each category.

Chapter 7 – Discussion and Recommendations

RQ 1 and 2: Activities done in Hood Canal (overall and differences between tourists and locals)

The data collected represents a non-random sample population of people who use the Hood Canal for leisure purposes. One major caveat of using this data is that it does not represent everyone who uses the Hood Canal and that people who chose to map may have different ways of using the region than people who didn't map. When looking at all of the respondents there are concentrations of activities around Port Townsend, along the canal starting at Dabob Bay and making its way down south to the great bend and Union. This big picture is split differently when looking at the local and tourist respondents. Hotspots show that locals predominately mapped activity sites around Quilcene and Brinnon area while tourists had many scattered activity sites and concentrations around Port Townsend, Hoodsport and Union. When looking at the different activity categories, there were differences in how the region was used but there was a higher frequency of mapped sites around the central region of Hood Canal near Quilcene and Dabob Bay.

The differences between tourists and locals may occur due to locals avoiding highly touristic areas based on previous experiences as well as knowing the region better and can therefore go to areas that are less used or not publicized or advertised. If data was only collected from locals, the tourist hot spots around Port Townsend, Alderbrook Resort/Union, Potlatch and Fort Flagler State Park, and Hoodsport may not have been accounted for and resources could potentially be misused.

Similar results were found in the Olympic Peninsula mapping project (McLain et al., n.d.), the Oregon Recreation Study (LaFranchi & Daugherty, 2011) and a Puget Sound Partnership Survey (Puget Sound Partnership, 2012). Recreation has been found to be highly valued among visitors and residents (Brown, 2006; McLain et al., 2013). The Olympic Peninsula mapping project revealed that ~70% of the outdoor activities residents mapped were recreational activities (McLain et al., 2013). As with this study, walking, hiking and climbing were most the often mapped activities by locals in the entire Olympic Peninsula study. In the Oregon recreation mapping study (LaFranchi & Daugherty, 2011), the majority of respondents mapped shore-based activities such as beach going and scenic enjoyment while very few mapped ocean-based activities. The current study found that fewer respondents mapped wildlife viewing than in the Oregon. Hood Canal is advertised to tourists as providing opportunities for shellfishing, fishing and hiking while the top activities advertised for the Oregon Coast is arts, birding, lighthouses, whale watching, farmers markets and beach activities ((Oregon Coast Visitors Association, 2014). The differences seen in the Oregon and Olympic Peninsula studies could also be attributed to different groupings of activities in order to run analyses and comparisons. The PSP survey was a phone survey rather than spatial. It found that many Puget Sound residents valued walking or hiking, gardening, reading and outdoor sports as activities done during their free time as well as fishing, camping, bicycling and skiing (Puget Sound Partnership, 2012). In the current study, fishing was not mapped as frequently when compared to the Puget Sound and Olympic Peninsula studies. This could be because respondents may not have wanted to share their fishing spots or due to different sampling techniques. Mapping online versus in person versus stating what a person does can result in different types of responses. This study was also not a representative sample which could account for some the differences seen in the results.

Frequency of activities:

Hypothesis 2 was supported as a chi squared test revealed that locals stay for a 1 day and participate in recreational activities at least 4 times a year while tourists go 1 to 3 times a year and stay for 2 to 4 days. The majority of tourists came from large urban centers that surround the Hood Canal watershed, Olympia and Seattle. Depending on where in the watershed a tourist visits, driving can take anywhere from 30 minutes to around 2 hours and may require a ferry ride. The tourism literature has shown that for weekend trips from urban centers show that destinations were within 2 hours' driving time from the tourist's home and that the longer the travel time, the fewer visits that are made to an area (Clawson & Knetsch, 1963; Mercer, 1970). Tourists also stayed for 2-3 weeks when visiting the region and this could be due to tourists who have second homes which can minimize costs associated with staying in the tourist destination and allow for tourists to stay for longer periods of time. The survey did not account for seasonality or day of the week when tourists and locals participate in activities which could also be a significant factor.

Recommendations for Brokers and the Public:

1. Brokers can take this data and use it as a simple baseline for monitoring tourism/recreational trends in the watershed as well as studying those areas to see the impacts of those activities on the environment. However, brokers must understand the limitations of using data from a non-randomized sample.
 - Brokers also need to collect more spatial data by reaching out and targeting other recreation groups such as hunters as well as respondents with lower educational

backgrounds since they were either not represented or underrepresented in this sample at all. Collecting more data might not resolve the issues associated with a non-random sample. Different methods should be used to reach out to a random and representative sample.

2. Based on this pilot study, brokers could consider focusing broad management actions around Port Townsend, Union, Quilcene-Brinnon area, and Hoodspport.
 - Managers can use this type of information to determine where to take action or how much to invest when deciding what amenities to provide nearby. For example, this could be done by determining if a hotel could be beneficial near a highly touristic area.
3. The differences seen can be used by brokers to more effectively allocate resources for different activities and different subgroups.
 - For example, resources could be spent on improving day facilities in hot spot areas of locals and amenities such as hotels or campgrounds could be built and/or amended around tourist hot spots.
 - Based on activities, resources spent on trail maintenance should be focused on areas with high concentrations of hiking.
4. The public (locals and tourists) can also use the maps when deciding where to go to participate in activities by avoiding the hot spot regions.

RQ 3: Perception Questions:

Hypothesis 1 was not supported due to a p-value greater than 0.05. Locals and tourists did not differ on how they perceived their activities impacted the health of Hood Canal and the current

status of the Hood Canal. This could be due to education efforts focused on a Puget Sound scale or more locally on just Hood Canal. Organizations such as the Puget Sound Partnership, Hood Canal Coordinating Council, county health departments and conservation districts all provide information related to the waters of Hood Canal. The “Do Some Good for the Hood!” campaign alongside the “Puget Sound Starts Here” campaign have both been well received by the public and are dedicated to improving water quality by providing educational and stewardship opportunities (Washington State University Social and Economic Sciences Research Center, 2013).

Hood Canal is considered to be a part of the larger Puget Sound which probably factored in to why people from the Puget Sound region stated that the watershed is healthy. Both locals and tourists felt that the Hood Canal was healthy and no one stated it was unhealthy. Similarly, a Puget Sound Partnership (PSP) survey of Puget Sound waters, found that overall, respondents “think the health and conditions of the waters in and around the Puget Sound are good or excellent”. Residents of King County were more likely (31%) to rate the health and condition of Puget Sound as good or excellent than Hood Canal residents (28%) (Puget Sound Partnership, 2012). Hood Canal residents did not state that they felt that the Hood Canal was very healthy. This could be due to local education efforts that are focused on reducing human impacts on water quality or residents of the area think that there are different factors that affect only the waters of Hood Canal, and not the Puget Sound, such as septic systems and the low dissolved oxygen.

Hypothesis 2 was also not supported because respondents primarily stated that non-consumptive activities such as touring, wildlife viewing, stewardship/scenic enjoyment and non-motorized

shore/land activities had an impact. Respondents disagreed more than expected that the consumptive activity of fishing and shellfishing had an impact. Overall, tourists and locals disagreed or felt neutral about their activities impacting the health of the watershed. This could be due to low participation in specific activities throughout the year, that respondents felt that it had no impact, or the lack of education efforts on how to minimize impacts on the environment. The PSP survey found that residents are most likely to tell others about activities that have low or no impact on the environment (Puget Sound Partnership, 2012). Over half (57%) reported that the activity they are most likely to tell others about had a low (40%) or no impact (17%) on the environment, while over one quarter (27%) reported that their activity had moderate impact and few (14%) reported that their activity had a high impact on the environment. Puget Sound residents stated that they know that their actions can impact the environment and most stated that they may take the appropriate steps to minimize their impact if they knew the activity had a moderate to high impact on the environment (Puget Sound Partnership, 2012). These steps include seeking out information on ways to reduce the environmental impact. Through these educational campaigns, tourist and locals may be modifying their behavior when they participate in activities in the Hood Canal. PSP noted that most Puget Sound residents saw themselves as people who do something to protect the environment and, intellectually, know the impact that their actions can have on the Puget Sound's health.

Only tourists agreed that activities falling under the wildlife viewing, touring, and stewardship/scenic enjoyment categories impacted the health of the Hood Canal. In non-motorized water activities, locals and tourists agreed that their activity had an impact. This can be explained by the fact that stewardship activities are protecting the environment and therefore

impacting the Hood Canal but in a positive way. Tourists may have felt that when viewing wildlife, this activity could potentially disturb the natural habitat of the wildlife and therefore have an impact. This could also apply to non-motorized water activities disturbing the habitat of water species and therefore impacting the environment.

There was a significant difference between expected and observed values of tourist and locals' perceptions about non-motorized shore activities impact on the environment. When comparing just disagreement and agreement with the statement, locals disagreed more than expected while locals agreed more than expected. This could be due to a low sample size of respondents because no one in the local subpopulation stated that they agreed with the statement.

Recommendations:

Educational efforts should continue and can be focused at highly concentrated areas around Hood Canal.

1. Educational information should emphasize the impacts of different types of activities can have, not just one type or general category. The information should represent the positive/negative impacts not just on the environment but on resident communities.
 - For instance, stewardship activities can bring about positive ecological change and many tourist activities can provide economic opportunities to the region.
2. Brokers should also provide information on how a person can take action or participate in activities that improve the water quality of the Hood Canal and not just focus on ways to reduce the impact of a negative activity.

3. Brokers should also strive to find a way to make tourists and locals feel comfortable to share activity sites and activities that have a moderate to high impact on the environment as well as monitor areas to determine the validity to locals/tourists beliefs on the impact of their activity.

RQ 4: Gender, Age, Education Level

Gender and age did not seem to have an impact on participation in the online survey. I found that gender and age of the respondents were similar to US Census Bureau data for Washington residents and the counties surveyed. The apparent significant difference was due to normal differences in age between the counties surveyed and the rest of the state. Education level was an exception with a very high overrepresentation of people who have a bachelor's degree or higher.

According to the US Census Bureau, females make up 50.6%, 48.3% and 49.1% of the population in Jefferson, Mason, and Kitsap Counties and 50% in Washington State. A study conducted to collect information about the demographic, economic and social characteristics of Hood Canal residents revealed a higher percentage of women who responded more than males while females responded less in this survey (Washington State University Social and Economic Sciences Research Center, 2013). Even though there are unequal percentages among the genders, a $p\text{-value} > 0.05$ indicates that there were no more females than expected in either population subgroup and gender was similar to the US Census data.

The US Census reveals that there is a much higher percentage of persons over 65 years old living in Hood Canal than in Washington with 30.5%, 20.6%, and 15.3% in Jefferson, Mason, and

Kitsap versus 13.6% in Washington State. The median age in Washington State is 37.3 and the survey found a median age for tourists at 38 years old. The median age of locals was 51 which was higher than either Kitsap or Mason's County median (39 and 44) but about equal to Jefferson county (53) (Washington State University Social and Economic Sciences Research Center, 2013). The largest proportion of respondents was from Jefferson County and Mason County (40% each) which would account for median age being older (Appendix V). The median age of the Census data indicates that the older age of the survey respondents was representative, or close to representative, of the area population.

In this study there was overrepresentation of bachelor and graduate degrees in both population subgroups. 95% of tourists and 76% of locals stated that they have a bachelor's degree or higher while according to Census data, 32% of Washington State residents have a bachelor's degree or higher. Jefferson County was the only Hood Canal County that, according to Census data, has a higher percentage than Washington State. The most stated occupation was retiree who all had a bachelor's degree or a graduate degree. 10% of respondents stated that they were a scientist, researcher, biologist, student or a teacher and all had graduate degrees.

The opt-in nature of the survey represents a non-random sampling technique but in this case, certain demographics represented the larger population as compared to Census data such as gender and age. However, a more encompassing range of potential participants should be targeted to ensure that education level is not a factor in mapping and may just be an outcome of opt-in surveys. Using InSEAM did not seem to exclude any participant that was over 65 years old since there was a higher number, than expected, of respondents in the 65+ age group for

locals and 55-64 age group for tourists. Participants with less formal education were underrepresented in the study which could have been due to lack of access to a computer or the internet or lack of knowledge about mapping. Higher educational attainments may have provided respondents with more experience in using computers or with potential familiarity with mapping.

Study Limitations:

There was a low response rate which could be attributed to different factors such as the duration of survey collection, length of survey, ease of mapping, and the amount of instruction given. The survey was only open for a one month period which limited the amount of respondents and future research should factor in more time to collect data. The study also represented a point in one time that generally has less tourist/recreational activity, late winter/early spring. The opt-in nature of the survey results in certain groups being underrepresented due to lack of access to the study. This lack of access could have been caused by a variety of reasons such as they did not receive an email because they were not in the network of participants, do not have access to email, or they were uncomfortable/unfamiliar with online mapping tools. Lastly, InSEAM itself may have been too difficult for participants without actual guidance or more instructions.

RQ 4. Evaluation of InSEAM as a tool

As a researcher, InSEAM, like other online mapping tools, was effective in collecting data stored in GIS format since it removed the need to digitize paper maps or convert into GIS formats. It also provided a simple way to engage stakeholders by allowing them to complete the survey at their convenience and on one webpage instead of one site for the online map and another for the

survey. Some users found the tool difficult which could be due to not understanding GIS jargon or unfamiliarity with mapping in general.

In order to collect demographic information or ask any general questions about the region, the tool required that these questions be asked before a respondent gained access to the actual map. This may have created some user fatigue and limited the amount of responses provided. Based on email communications, the mapping activity seemed complicated for certain users to even try and required either extra assistance/instructions or people withdrew from the survey. Very few people contacted the researcher but those who did consistently mentioned difficulties in understanding how to use the tool (Appendix VI). Potential respondents noted that the online survey was “difficult”, “time-consuming”, “complex”, “user unfriendly” and some requested “simplifying” the questions and additional “instructions”. With some respondents, these issues were quickly addressed with a response email that provided the same information as the consent email but attached pictures of what the instruction was referring to.

Recommendations on Methodology:

To make InSEAM a more effective research tool, I would recommend the following based on the interactions with potential participants:

1. Provide participants with pictures along with each step so they can reference as well as provided detailed explanations of GIS jargon such as polygon, point and line.
2. Create a short video of someone going through the survey and mapping.
3. Send out letters in the mail to potential participants with the link and information on how to navigate the survey in addition to reaching out by email.

4. It could be beneficial to also hold a workshop for people to attend where the survey is still completed online and on computers, so people can have an opportunity to take the survey while having the ability to ask questions about the process or how to use the tool as well as see a demonstration.
5. Lastly, if people in the region are not familiar with the mapping program, attend local meetings or host a webinar to educate people on how to map using GIS/InSEAM.

Summary of Hypotheses:

In summary, InSEAM was an effective tool to collect recreation/tourism spatial data but the use of an online platform overrepresented graduate degrees in the sample size. In this sample, we saw that respondents mapped certain areas in Hood Canal more frequently than other locations and that tourists and locals use the region differently. There was also a significant difference in the frequency and duration of stays between tourists and locals.

	Supported?
RQ1 H1: Certain areas are used more extensively than other.	Yes
RQ2 H1: Tourists have multiple different sites than locals where they participate in leisure activities.	Yes
RQ2 H2: Locals will visit recreational sites more frequently throughout the year but for a shorter amount of time than tourists.	Yes
RQ3 H1: Locals will perceive their activities to have a higher impact on the health of Hood Canal.	No
RQ3 H2: People who participate in consumptive activities will state their activities have a higher impact on the ecosystem.	No
RQ4 H1: Gender, age and education is a significant factor in who completes the online survey. There will be a higher number of younger, well-educated female participants.	No
RQ5 H1: InSEAM is an effective online tool for researchers	Yes
RQ5 H2: Responses will be limited to highly educated users more familiar with mapping terminology.	Yes

Table 5: Summary of Hypotheses.

CONCLUSION

Tourism studies are not just about tourists but should also factor in the recreation activities of locals and the brokers who facilitate the activity. This thesis used an expanded GIS methodology and a tourism model to study and examine mapped leisure activities of locals and tourists in Hood Canal, WA. The results have shown that from our sample population, tourists and locals used the Hood Canal watershed differently and overall, mapped activity sites along specific parts of the watershed. The survey also revealed that locals tended to participate in day long trips while tourists visited the region for 2-4 days and 2-3 weeks. InSEAM was effective in collecting and analyzing social spatial data. Ideally I hope this methodology and results will be useful to brokers, in the BLT model, when managing and monitoring tourism/recreational activities in the area. The results of this study can be useful not just to brokers but also to tourists and locals in order to get a better visual understanding of how the region is used.

In conclusion, the mapped activity sites of the respondents showed that there are statistically different areas that tourists and locals use as well as overall hot spots of activities around Port Townsend, the central region along the Hood Canal, Union and the Olympic National Park. Even though the sample size was small, the results show the potential to use an online mapping tool to collect spatial data. Social spatial analyses using a GIS methodology has an application in watershed management because it helps us understand constituents visually and statistically. The tool is inexpensive to use and the map outputs are understandable to people.

Future Studies

The BLT model recognizes the social structure of the tourism system. However, broker's activities/locations were not analyzed in this thesis but should be done in the future to get a

complete understanding of the system. Future studies can also analyze and incorporate seasonality to see if hotspots change depending on the season as well as factor in a new population subgroup, second homeowners in the Hood Canal. The data collected from the Olympic Peninsula on values and outdoor activities can also be recoded to identify locals of Hood Canal and tourists from the rest of the Olympic Peninsula and merged with this research to create a larger dataset and see if these hotspots still remain the same. Ultimately, this method, alongside with a more randomized sampling scheme to collect larger and more accurate data, can be applied to other areas that need social spatial data.

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APPENDICES

Appendix I: Online Survey Using InSEAM Annotator

Link: http://ncp-dev.stanford.edu/~inseam/hood_canal/

Log in page:

InSEAM Annotator Instructions

1. Add a point, line, or polygon to the map by first choosing one of the three tools at the top of the screen, and then drawing directly onto the map. Lines and polygons can be complex shapes, consisting of many points, and are completed by double-clicking the mouse.
2. Continue to add shapes. Or, to delete a feature, hover the mouse pointer over the shape and press the *Delete* key on the keyboard.
3. Click the **Map not yet modified** button to store your current map in the database.
4. To start a new map, click the **Reset Map** button. Remember to save first; all unsaved data will be lost.

Please consider all the recreational activities you do in Hood Canal throughout the year. For each activity, please map the TOP THREE LOCATIONS in which you participate in each activity and describe why that specific location. Please mark only within the highlighted area.

REMEMBER, TO SAVE THE MAP THROUGHOUT THE PROCESS.

Examples of recreational activities: This list is to provide you with a general idea of some activities you may do in Hood Canal but is not comprehensive and you may choose an activity that is not listed below. Please be as detailed when describing your selected recreational activity. Remember to think of activities you do throughout the entire year in Hood Canal: *Touring, Harvesting, Backpacking, Bicycling, Horseback riding, Hiking, Easy nature walks, Photography, Wildlife viewing, Bird watching, Star gazing, Fishing, Plant/Fungi Foraging, Shellfishing, Swimming, Sunbathing, Sailing, Surfing, Snorkeling/SCUBA diving, Canoeing/kayaking, Boating, Whale watching, Hunting.*

Please Log In

Zip Code (Primary Residence)

How many years have you lived in this county?

Gender

Year of birth

What is your education level?

What is your occupation?

What year did you first visit/move to the Hood Canal region?

Throughout the year, how often do you participate in recreational activities in Hood Canal?

What is the length of a typical stay/recreational activity in Hood Canal?

The current state of Hood Canal (rank between 1-5, 1 is unhealthy, 5 is very healthy)

The community's activities threatens the overall health and function of Hood Canal (rank between 1-5, 1 disagree strongly, 5 agree strongly)

My recreational activities affect the overall health of Hood Canal (rank between 1-5, 1 disagree strongly, 5 agree strongly)

InSEAM Annotator Controls: **Map not yet modified**

drawing directly onto the map. Lines and polygons can be complex shapes, consisting of many points, and are completed by double-clicking the mouse.

the TOP THREE LOCATIONS in which you participate in each activity and describe why that specific location. Please mark only within the highlighted area.

d Canal but is not comprehensive and you may choose an activity that is not listed below. Please be as detailed when describing your selected recreational activity. Remember to think of activities you do throughout the entire year in Hood Canal: *Touring, Harvesting, Backpacking, Bicycling, Horseback riding, Hiking, Easy nature walks, Photography, Wildlife viewing, Bird watching, Star gazing, Fishing, Plant/Fungi Foraging, Shellfishing, Swimming, Sunbathing, Sailing, Surfing, Snorkeling/SCUBA diving, Canoeing/kayaking, Boating, Whale watching, Hunting.*

Map data ©2014 Google

InSEAM Annotator Instructions

1. Add a point, line, or polygon to the map by first choosing one of the three tools at the top of the screen, and then drawing directly onto the map. Lines and polygons can be complex shapes, consisting of many points, and are completed by double-clicking the mouse.
2. Continue to add shapes. Or, to delete a feature, hover the mouse pointer over the shape and press the *Delete* key on the keyboard.
3. Click the **Map not yet modified** button to store your current map in the database.
4. To start a new map, click the **Reset Map** button. Remember to save first; all unsaved data will be lost.

Please consider all the recreational activities you do in Hood Canal throughout the year. For each activity, please map the TOP THREE LOCATIONS in which you participate in each activity and describe why that specific location. Please mark only within the highlighted area.

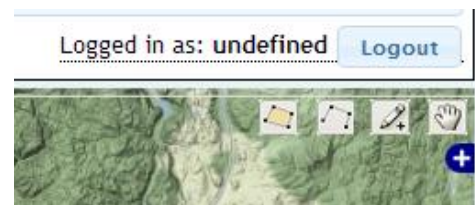
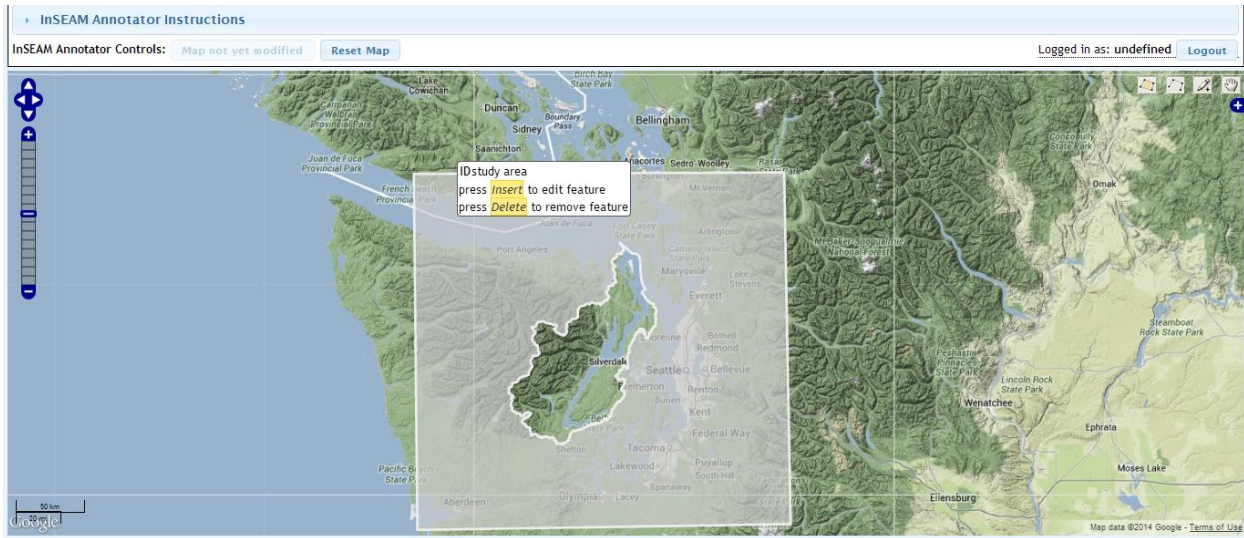
REMEMBER, TO SAVE THE MAP THROUGHOUT THE PROCESS.

Examples of recreational activities: This list is to provide you with a general idea of some activities you may do in Hood Canal but is not comprehensive and you may choose an activity that is not listed below. Please be as detailed when describing your selected recreational activity. Remember to think of activities you do throughout the entire year in Hood Canal: *Touring, Harvesting, Backpacking, Bicycling, Horseback riding, Hiking, Easy nature walks, Photography, Wildlife viewing, Bird watching, Star gazing, Fishing, Plant/Fungi Foraging, Shellfishing, Swimming, Sunbathing, Sailing, Surfing, Snorkeling/SCUBA diving, Canoeing/kayaking, Boating, Whale watching, Hunting.*

InSEAM Annotator Controls: **Map not yet modified** **Reset Map**

Logged in as: undefined **Logout**





InSEAM Annotator Instructions

InSEAM Annotator Controls: Map not yet modified Reset Map

Logged in as: undefined Logout

25 km

Google

Map data ©2014 Google

Enter information about Feature

What activity do you do here?

☐ Please select

☐ Once a week or more

☐ Once a month or more

☐ Once per season (Fall, Winter, Spring, Summer)

☐ Once per year

☒ Less than once per year

What attracts you to this location?

During a typical trip, how much do you spend on average per day for this activity (please include hotel costs, food, tours, rental equipment, etc?)

What is your transportation mode to this location?

On average, how much do you spend on transportation to get to this location per day?

Ok Cancel

Enter Information about Feature

What activity do you do here?

- ☐ Please select
- ☐ Once a week or more
- ☐ Once a month or more
- ☐ Once per season (Fall, Winter, Spring, Summer)
- ☐ Once per year
- ☐ Less than once per year

What attracts you to this location?

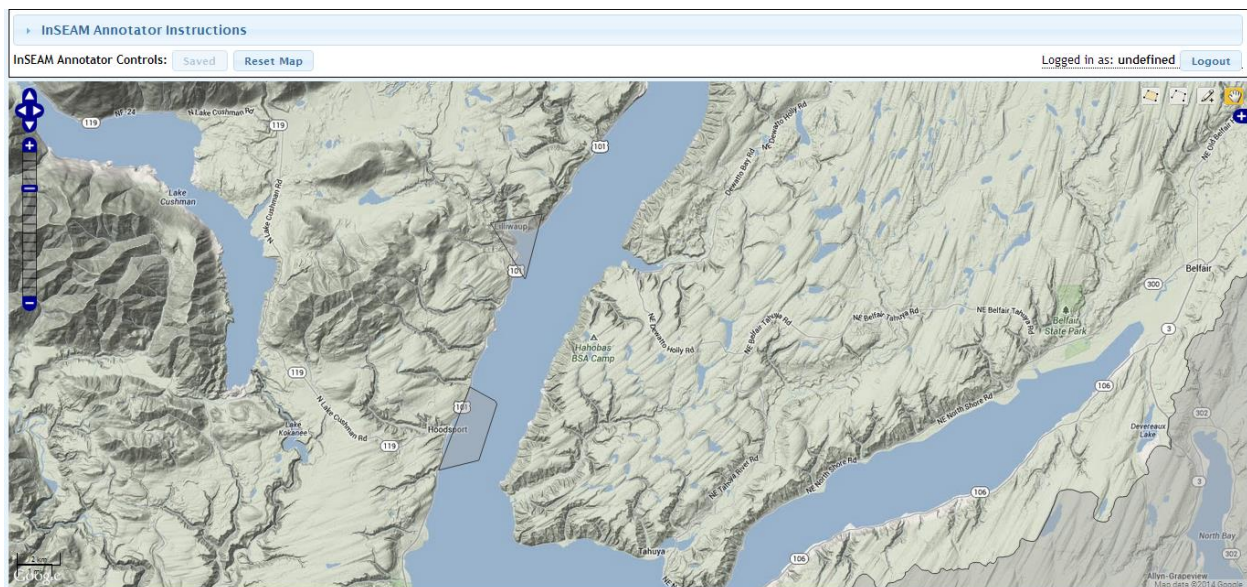
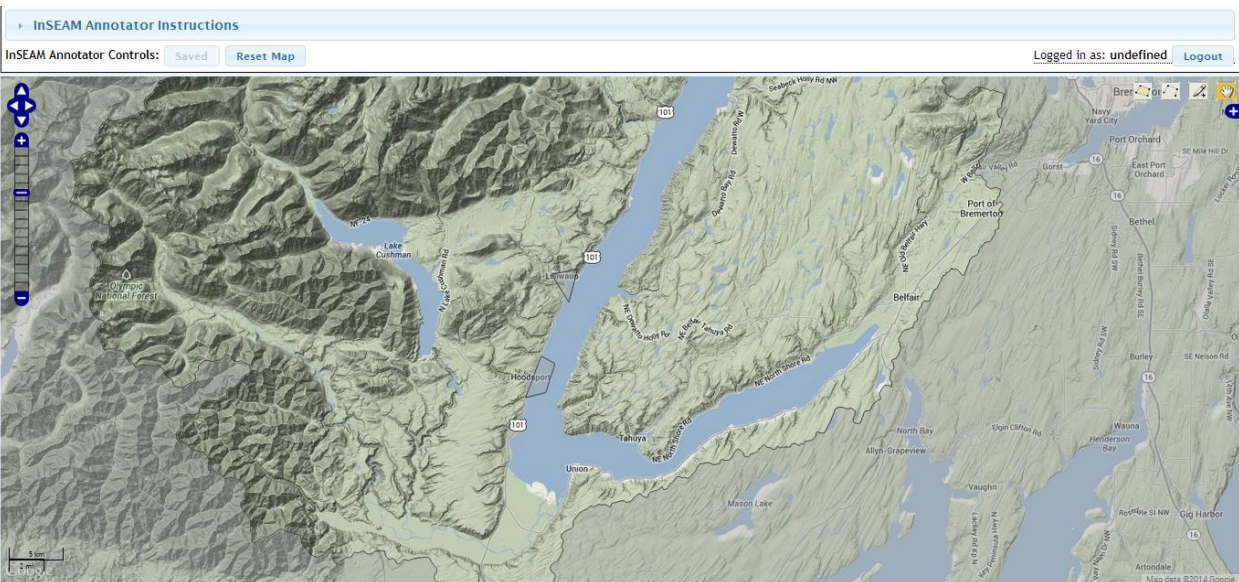
During a typical trip, how much do you spend on average per day for this activity (please include hotel costs, food, tours, rental equipment, etc?)

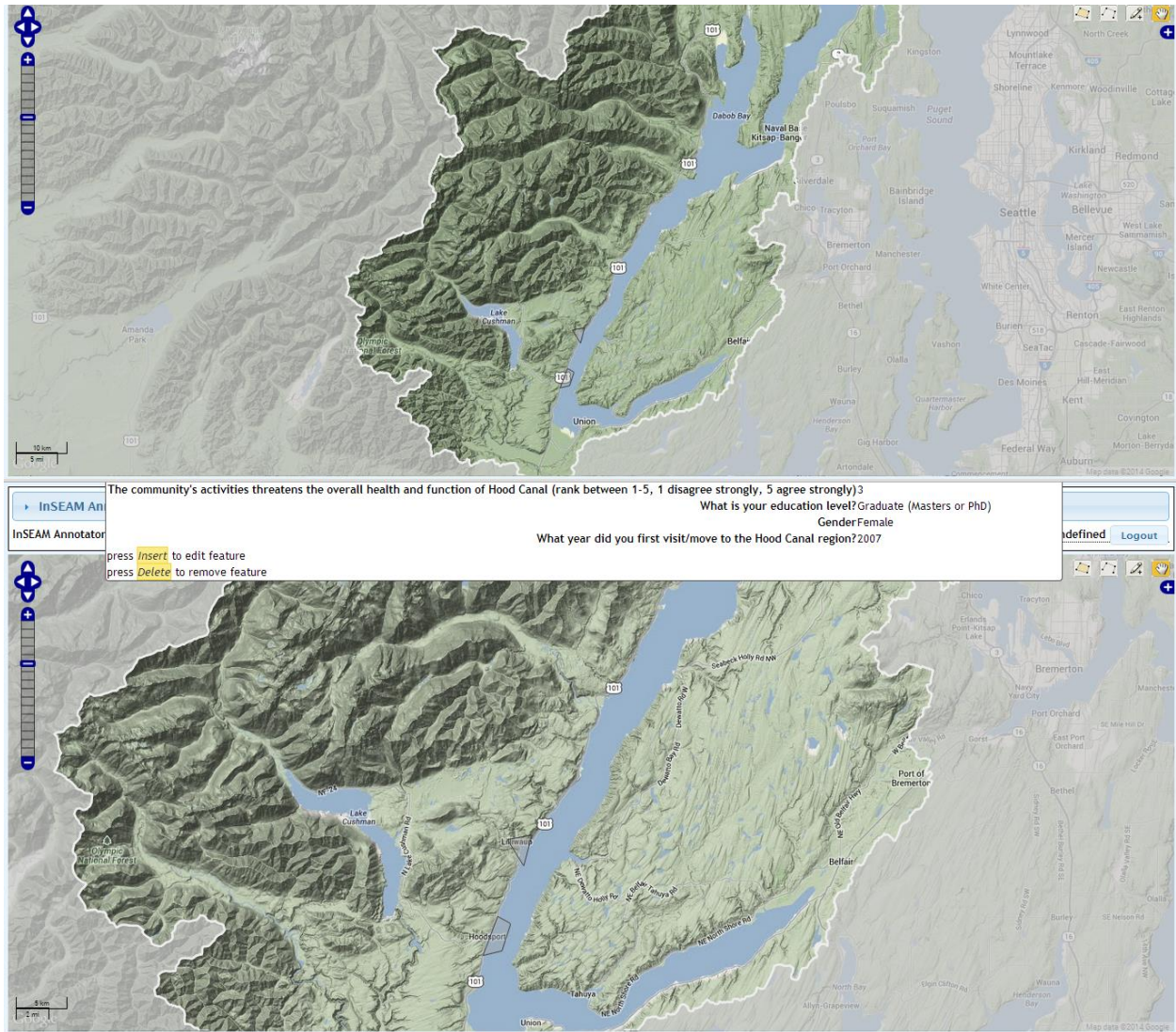
What is your transportation mode to this location?

On average, how much do you spend on transportation to get to this location per day?

Ok

Cancel





Appendix II: Survey Questions

Part A: Demographics/Background Questions:

1. Zip Code (Primary Residence): _____
2. How many years have you lived in this county? _____
3. Gender (Please Select)
Male _____ Female _____
4. Year of Birth: _____
5. Highest education level (Please Select):
Less than high school/GED _____
High School Diploma/GED _____
Associates degree _____
Bachelor's _____
Graduate (Masters or PhD) _____
6. What is your occupation? _____
7. What year did you first visit/move to the Hood Canal region? _____
8. Throughout the year, how often do you participate in recreational activities in Hood Canal?
____ 1 time ____ 2 – 3 times ____ 4 – 5 times ____ > 5 times a year
9. What is the length of a typical stay/recreational activity in Hood Canal (Please mark one):
____ 1 day
____ 2-4 days
____ 1 week
____ 2-3 weeks
____ 1 month
____ > 1 month
10. The current state of Hood Canal (1 is unhealthy, 5 is very healthy)
11. The community's activities threatens the overall health and function of Hood Canal (rank between 1-5 with 1 being strongly disagree and 5 being strongly agree)
12. My recreational activities affect the overall health of Hood Canal (rank between 1-5 with 1 being strongly disagree and 5 being strongly agree)

Part B: InSEAM map annotator:

Note alongside annotator instructions:

Please consider all the recreational activities you do in Hood Canal throughout the year. For each activity, please map the **TOP THREE LOCATIONS** in which you participate in each activity and describe why that specific location. Please mark only within the highlighted area.

REMEMBER, TO SAVE THE MAP THROUGHOUT THE PROCESS.

Examples of recreational activities: This list is to provide you with a general idea of some activities you may do in Hood Canal but is not comprehensive and you may choose an activity that is not listed below. Please be as detailed when describing your selected recreational activity.

Remember to think of activities you do throughout the entire year in Hood Canal.

Touring	Plant/Fungi Foraging
Harvesting	Shellfishing
Backpacking	Swimming
Bicycling	Sunbathing
Horseback riding	Sailing
Hiking	Surfing
Easy nature walks	Snorkeling/SCUBA diving
Photography	Canoeing/kayaking
Wildlife viewing	Boating
Bird watching	Whale watching
Star gazing	Hunting
Fishing	

When the person does tag a location, these questions come up for them to answer:

1. What activity do you do here?
2. How often do you go here?
Please choose from:
☐ Once a week or more
☐ Once a month or more
☐ Once per season (Fall, Winter, Spring, Summer)
☐ Once per year
☐ Less than once per year
3. What attracts you to this location?
4. During a typical trip, how much do you spend on average, per day for this activity (please include hotel costs, food, tours, rental equipment, etc...) _____
5. What is your transportation mode to this location?
6. On average, how much do you spend on transportation to get to this location per day?

Appendix III: IRB Approved Consent Form

To Whom It May Concern,

You are being invited to participate in a research study about recreational activities in Hood Canal. I am a current graduate student in the School of Marine and Environmental Affairs at the University of Washington. For my master's thesis, I am conducting a study on recreational activities in Hood Canal between residents and tourists using an online mapping software in order to aid in the management and restoration of the Hood Canal watershed. This study will also test a method for gathering recreation/tourism data using an online tool. Through your involvement, I will be able to make recommendations on how management organizations can incorporate social spatial data into their decision making.

There are no known risks or costs if you agree to participate in this research study. Participation in this study is voluntary and there is no penalty if you do not participate. The hosing site will collect IP addresses; however, that information will not be accessed by any of the researchers. The online survey will take you anywhere from 15 minutes to 45 minutes to complete. If you wish to decline or withdraw from participating in the online survey you may do so at any time without penalty or loss of benefits to which you are otherwise entitled.

Once the online surveys are completed, I will aggregate the data in GIS. Data will be store securely and without any names or identifiers in order to ensure anonymity. All responses will be used for comparison and statistical purposes and your confidentiality is guaranteed. Final data may be provided to the Hood Canal Coordinating Council for potential planning use.

Thank you for your participation in this survey. I hope you will spend the time to complete this online mapping survey. Without the help of people like you, research like this could not be conducted. If you have any questions or concerns about completing the online mapping survey or about being in this study, please contact Adi Hanein at ahanein@uw.edu.

The University of Washington Institutional Review Board has reviewed my request to conduct this project. If you have any concerns about your rights in this study, please contact the University of Washington Human Subjects Division at (206) 543-0098. .

By clicking the link below, I give my consent to voluntarily participate in this study. I have read and understood the above information and am over 18 years old.

http://ncp-dev.stanford.edu/~inseam/hood_canal/

Sincerely,

Adi Hanein
Master's Candidate
School of Marine and Environmental Affairs
University of Washington

Appendix IV: Metadata

Demographic Data							
	Population Group	Gender	Education Level	How often do you participate in rec activities/per year (general)	Length of a typical stay in Hood Canal (General)	How often do you go here (specific to activity)	Transportation Mode
0	Resident	Male	Less than high school	1 time	1 day	Once a week or more	Car
1	Tourist	Female	High school diploma/GED	2-3 times	2-4 days	once a month or more	Ferry
2			Associates Degree	4-5 times	1 week	once per season	Boat
3			Bachelors	> 5 times a year	2-3 weeks	once per year	
4			Graduate (Masters or PhD)		1 month	less than once per year	
5					>1 month		

Awareness Questions			
	Current health of Hood Canal	Community's activities impacts overall health of Hood Canal	My activities affect overall health of Hood Canal
1	Unhealthy	Disagree Strongly	Disagree Strongly
2	Slightly Unhealthy	Disagree Strongly	Disagree Strongly
3	"ok"	Neutral	Neutral
4	Slightly Healthy	Agree	Agree
5	Healthy	Agree Strongly	Agree Strongly

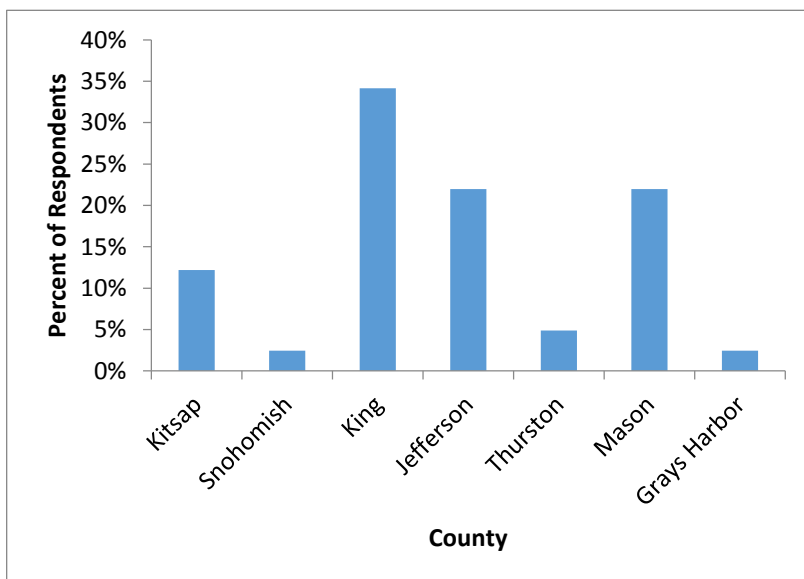
Appendix V: Detailed Demographic Data

1. Occupation Data

Specific	Counts	Percentage
Retired	7	18%
Scientist/Research/Biology	4	10%
Student	3	8%
Faculty/Professor	2	5%
Environmental Health Specialist	2	5%
Environmental Specialist	2	5%
Administrative/Office Assistant	2	5%
Architect	2	5%
Epidemiologist	1	3%
Natural Resources Planner	1	3%
Operations Manager - Maritime Sector	1	3%
Registered Nurse	1	3%
Forester	1	3%
Teacher/Educator	1	3%
Victim Advocate	1	3%
Juvenile Probation	1	3%
Banker	1	3%
Builder	1	3%
Business Owner	1	3%
Consultant	1	3%
Engineering Management	1	3%
Grants Manager	1	3%
Recreational SCUBA Diver	1	3%
Planning Manager	1	3%
Total	40	

2. Zip Code Data

County	City	County
Kitsap	Bremerton	1
	Bainbridge	2
	Port Orchard	1
	Seabeck	1
	Total	4
Snohomish	Edmonds	1
	Total	1
King	Kent	1
	Vashon	1
	Seattle	12
	Total	14
Jefferson	Brinnon	1
	Quilcene	6
	Port Townsend	2
	Total	9
Thurston	Olympia	2
	Total	2
Mason	Allyn	1
	Belfair	2
	Shelton	6
	Total	9
Grays Harbor	Quinault	1
	Total	1



Appendix VI: InSEAM Quotes from Respondents

Very few people contacted the researcher but here are the excerpts regarding the ease of using

InSEAM:

1. “This is to let you know that I tried to respond to this request but had too difficult and time-consuming an experience utilizing the tool. I wish you luck in your research work. I recommend simplifying this so that respondents have a seamless time giving you the information you want”
- “I am asked to participate in survey's regularly. This is the most opaque and user unfriendly one I have ever encountered. If you can provide instructions for what I am to do to make this work I would be happy to participate”
- “I attempted to fill out your survey but found it way to complex”
- “...it may be just me but I was unsuccessful in completing your survey. The "shape tool" does not seem to outline where I live and since I am a resident on the shore of the Hood Canal, the questions seem to not apply. The whole map application is clumsy and difficult to manipulate.

Appendix VII: List of all activities, after cleaned up for consistency and spelling.

Backpacking
Beach Combing
Beach front park
Beach Walking
Biking
Bird Watching
Boarding
Boating
Camping
Canoeing/Kayaking
Diving
Easy nature trails
Family Reunion
Fishing
Forestry
Hiking
Nature Appreciation
Nature Walking
Photography
Picnicking
Plant/Fungi Foraging
Relaxation
Restoration
Sailing
Shellfishing
Swimming
Touring/Sight Seeing
Walking
Whale Watching
Wildlife viewing
Wind Surfing

*Bolded activities are the top 10 activities mapped by respondents.