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PARTICIPATORY WEB GIS DESIGN – A SUSTAINABLE RECREATION DECISION SUPPORT SYSTEM FOR MISSOULA COUNTY

By

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Thesis

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Participatory Web GIS Design – A Sustainable Recreation Decision Support System, for Missoula County

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Sustainable recreation ensures that local communities benefit from the effects of recreation. A recreation decision support system (RDSS) is a common way for people to gather information about an area they are about to visit. This research explores: 1) how well can local representatives' knowledge concerning appropriate recreation behaviors be incorporated into a WebGIS that will serve as a RDSS, 2) what layers, activities, and information do participants want to include in a RDSS, and 3) how well does the ArcGIS Online perform in incorporating representatives' knowledge of areas of significance for a RDSS?

Recreationalists in Missoula County, Montana, have diverse recreational landscapes to choose from, and places that are of significance to a diverse set of groups to be respectful of. This research explores the participatory GIS (PGIS) method using a focus group comprised of community interest groups for initial content scoping, WebGIS design, and final evaluation of the RDSS. This is a novel approach to test how to incorporate local representatives' knowledge into a RDSS tool.

This research revealed that local interest groups indicated that identifying allowed recreation activities, leaving no trace, and low impact forms of recreation were the most appropriate to incorporate in the RDSS. The themes of accessibility, community and conservation, wildlife, and wilderness emerged as to why interest groups value recreation areas. Additionally, providing information on regulations, infrastructure, history, recreation activities, and wildlife would help promote sustainable activities. Participants indicated that layers, icons pop-ups, and queries were identified as adequate ways to inform users of the recreation opportunities in the area. Results demonstrate that the PGIS process is a successful method for creating a sustainable recreation map for a community by using participants from a diverse set of interest groups.

Keywords: Participatory GIS, Sustainable Recreation, Recreation Decision Support System, Web GIS Design.

TABLE OF CONTENTS

LIST OF FIGURES v
LIST OF TABLES v
Introduction 1
Objectives 4
Conceptual Framework 5
Sustainable Recreation 5
Participatory GIS 7
Collaborative Planning & PGIS 10
WebGIS 12
WebGIS Design 14
Concluding Remarks 17
Study Area 17
Methodological Approach 20
Step One: Strategy 21
Step Two: Design a Spatial Database 24
Step Three: The Design of the Web Map 25
Step Four: The Design of the Map Browser 26
Step Five: Evaluate ArcGIS Online RDSS 26
Content Analysis 27
Results 29
The Focus Group 29
Identified Map Content 31
Question 1: Areas of Significance 31
Question 2: What Participants Value 35
Question 3: Most Acceptable Behaviors 38
Question 4: Promoting Sustainable Activities 40
Question 5: Map Design 43
Resulting RDSS 44
RDSS Evaluation 47
Content 48

Performance 49
Usefulness 51
Discussion 51
The PGIS Method 52
Sustainable Recreation 55
PGIS and Collaborative Planning 56
Web GIS Design 58
Conclusion 60
Project Structure 60
Future Research 62
References 64
APPENDIX 68
APPENDIX: A 69
APPENDIX: B 73
APPENDIX: C 75
APPENDIX: D 78

LIST OF FIGURES

1. Figure 1 – Missoula County land ownership……18
2. Figure 2 – Diagram of the development and evaluation process used to create the web application……21
3. Figure 3 – Map of Missoula County used by participants to locate areas of significance……34
4. Figure 4 – The Sustainable Recreation Decision Support System interface……45

LIST OF TABLES

1. Table 1 – Participating Interest Groups……22
2. Table 2 – Data categories and layers identified to include in the RDSS……..25
3. Table 3 – Focus group content analysis: frequency of themes that were discussed during the focus group……..32

Introduction

Missoula County, located in Montana west of the Continental Divide of the Northern Rocky Mountains, has a physical geography which allows residents and visitors to climb towering mountains, wade or float a winding river, or stand atop sweeping plains enjoying their favorite activity. In addition to its diverse recreational landscape, the county also contains places of significance to a diverse set of groups; such places include areas of cultural significance and areas set aside for conservation. Choosing where and how to recreate is important in order to respect what other interest groups may value. For example, for the Confederated Salish & Kootenai Tribes (CSKT) of western Montana, a towering mountain may carry cultural significance that a mountain climber is not aware of. Understanding the landscape and choosing places to recreate can be difficult when trying to avoid these areas of significance and potential "disturbances" to them. This demonstrates the need to have a tool that provides recreationalists with information that they can use for making sustainable recreation choices.

The World Travel and Tourism Council defines sustainable recreation as "operating in harmony with the local environment, community, and cultures, so that these become the permanent beneficiaries not the victims of recreation development" (WTTC 1995, 30). In Missoula County, wildlands connect with and complement the communities that are found there. While the prospect of free or near-free land for settlement, and mineral, timber, and other natural resources attracted the area's first non-indigenous inhabitants, its scenery, free-flowing streams, and charismatic wildlife continues to attract new residents and visitors alike, and the prospect of harvesting wild foods and materials is important today too (USFS 2015, 7). In order to fulfill the mission of sustainable recreation

and keep this relevant for local communities, collaboration between user groups, other public recreation providers, and communities is important to consider.

Missoula County is composed of many landscapes, with diverse interest groups. An interest group, for the purpose of this study, is any group which places a cultural value on the land, owns land, has economic interests, depends on public areas for recreation services, or has conservation interests. Interest groups are often focused on or most concerned with their interests. Where is the next peak we should go climb? Where is land in a more natural state, allowing immersion in nature? It can be easy to miss the meaning an area has to other communities or groups. A user group would include individuals who are tourists or who have little prior connection to the land and resources in the area. An interactive map designed as a recreation decision support system (RDSS), including the input of representatives from interest groups, would help users and user groups operate more in harmony with the local environment, communities, and cultures.

Launched in 2005, Google Maps and Google Earth allowed public access to a large amount of geographic information. This allowed people to interact with geographic information and to make spatial decisions via the internet. More complex spatial tools since the release of Google Maps include special purpose interactive maps such as those provided by federal land management agencies (recreation.gov) and Hike Wild Montana (hikewildmontana.org) that can aid people planning a recreational trip and help the public choose a trail or hiking area. However, neither of these interactive maps considers the cultural significance of the areas they cover, or appropriate sustainable recreation activities, practices, and behaviors. While in the very recent past, the creation of special purpose interactive maps required significant programming skill and training in web design,

this is no longer necessarily the case. ArcGIS Online, was released in 2012 by ESRI™ providing a platform for cartographers with limited programming skills to build a web-based geographic information system, or interactive map that can be published to and is accessible from the World Wide Web. This online software platform, and others like it, are now generally known as WebGIS (Carver 1999, Fu and Sun 2011).

In order to further sustainable recreation that is respectful of the interests of diverse interest groups, it is necessary to have a way to inform users of the significance that areas carry – online interactive maps would seem to hold promise. But, *just how to incorporate local representatives' knowledge into a tool such as an online interactive map* is an area that needs further exploration in the area of WebGIS and recreation planning research. Participatory GIS (PGIS) seems to offer some guidance here given its focus on using GIS and mapping at local levels to produce knowledge of place (Brown and Webber 2011). This problem and question then lead to another – how can one best design an interactive map to appropriately balance thematic content, content pertaining to cultural and related significance and values, and usability for the average recreationalist?

The thesis research described here has two main goals. The first is to identify the cultural and ethical use issues that pertain to different recreational resources in Missoula for consideration and incorporation into a RDSS. This was accomplished by using a collaborative focus group process comprised of representatives from various interest groups. The use of a focus group created an environment where interest groups where able to show what they wanted to include in a RDSS and brainstorm collectively to decide on layers, functions, and information that was thought to be included (Berg 2004, 124). The second goal was to use ESRI's ArcGIS Online platform to construct an interactive map

for people who want to explore the outdoors in Missoula County using the outcomes of the focus group process. This tool was then assessed by the same focus group to identify usefulness, functionality, and how well it is able to convey their given interests. Thus, the intent of this research was to develop and test a methodology for the improvement of sustainable recreation by providing publicly accessible geospatial information that can help individuals make respectful decisions.

Objectives

This research proposes that by providing public access to information that can help individuals make respectful decisions, an interactive map provides a platform for sustainable recreation when it is designed with PGIS methods under a collaborative planning framework. By paying attention to concerns that arose from interest group representatives during a focus group discussion, this study offers an in-depth look into the perceptions that different groups have of potential recreation areas and how activities such as hiking, mountain biking, climbing, fishing affect values corresponding to those significant areas. It also uncovered the utility of ArcGIS Online for creating an interactive map for sustainable recreation.

This study addresses the following questions:

1. How well can local representatives' knowledge concerning appropriate recreation behaviors be incorporated into a WebGIS?
2. What layers, activities, and information do participants want to include in a RDSS?
3. How well does the ArcGIS Online perform in incorporating representatives' knowledge of areas of significance for a sustainable recreation interactive map?

Conceptual Framework

Sustainable Recreation

Sustainable recreation is a topic of growing significance. Everyone has their own definition, but these often have the same goal in mind – making sure that recreation areas operate in a way to maintain the health of the environment, economy, and the culture of an area. One way that sustainable recreation can be achieved is through public participation. The World Travel and Tourism Council recognizes how important it is to have individuals, groups and organizations participate in decisions or projects, which potentially affect the communities in which they live and work (WTTC 1995). Through preventative actions, by including local groups in planning, the efforts of land managers, and the education of users, sustainable recreation is a feasible goal.

In August 2015 the USFS approved a strategy plan which focuses on sustainable recreation, heritage, and wilderness for its Region 1, the Northern Region (USFS 2015). Three main themes of this plan include: 1) *ecological sustainability* – making sure that settings and opportunities are compatible with the landscape's ability to support associated activities, use levels and infrastructure; 2) *socially sustainable* – sustained relevance by delivering desired benefits to local, regional and national constituents; and 3) *economically sustainable* – programs, facilities and services complement and contribute to local and regional economies while remaining within budget allocations.

As is evident from the World Travel and Tourism Council's focus on sustainable recreation in 1995, this is not a new concept. Grasseni (2004) discusses how residents of a village in northern Italy developed a map of the valley they live in in an attempt to at-

tract tourists. The main argument presented is that the macro level of policies and agencies and the micro level of local capacities and perceptions coexist and intertwine in the representations of locality. A group of local mountaineering experts (individuals knowing the local trails, and other types of firsthand experience) engaged in planning to help create a map of a local valley to attract tourism. This involved remembering and documenting the history of their valley, including place names and forgotten paths and tracks. The experts included in the project represented botanists, marathon runners, local hunters, alpine guides, and amateur photographers. The aim of the team was to devise practical ways of suggesting to an outsider how to approach, observe, and attend to the landscape. Grasseni's (2004) view was that the landscape is highly anthropic and place names testify to this. As with the landscape in the northern Rocky Mountains, each stream, each trail, and mountain may have a unique place name associated with it given by Native American Tribes and present day communities. In the spirit of sustainable recreation, it would be useful to convey these stories and how local communities view the area to visitors of an area.

Recreation areas today become more important as they are used for people to become familiar with and learn the meanings and history of the area they live in. Arni (2103) mentions that recreation planning and management should be conducted thoughtfully, since recreation and activities in natural protected environments could impose problems. Just like recreation planning and management, when creating a recreation map of an area the cartographer or WebGIS specialist should consider the potential impacts it could have to an area. Just how to create a map that does not adversely affect the environ-

ment or community has been explored using participatory GIS methods. Just as in planning, technical experts or planners often serve as specialists to the client when creating maps. Even though there is often a platform for the public to give input to plans (e.g., through public hearings), those managers often take control over the product of the planning process through this allocative structure. A more bottom-up approach would involve the public at the beginning to learn about its values relating to specific areas and convey this knowledge to others.

Participatory GIS

The advent of the internet as a communications medium over the last two decades has provided new opportunities to disseminate and gather information. Participatory geographic information systems (PGIS) and public participation GISs (PPGIS) are two platforms for assembling and communicating geographical knowledge gathered from individuals. PPGIS/PGIS is different than a conventional GIS which is any system for handling geographic data (i.e., designed to capture, store, display, communicate, transform, analyze, and archive georeferenced information) (Goodchild 2005). PPGIS and PGIS are processes or techniques of gathering local knowledge using geographic information systems in participatory planning processes.

There is some ambiguity in the use of the terms PPGIS and PGIS. Brown and Fagerholm (2015, 119) describe PPGIS as "typically implemented by government planning agencies or academics to enhance public involvement in developed countries for urban and regional planning, often using random sampling methods and digital mapping technology with a primary focus on spatial data quality." Alternatively, PGIS is generally used as a development tool to promote community identity, empowerment, and the

creation of social capital (Brown and Kytta 2014). Both PPGIS and PGIS engage the general public and stakeholders to identify a range of landscape characteristics that originate in place-based local knowledge instead of proxy data from literature or process modeling. By engaging interest groups' local knowledge of landscape and appropriate recreation behaviors, this thesis follows the PGIS approach.

There are many ways to gather public knowledge on a map via the web, a local computer or an analog map. Carver et al. (2001) examined the utility of PGIS by examining users' experiences with a hot spot mapping tool to determine community members' feelings on a space of open ground that is to be developed. Their study found that the web-based system was both useful and popular among particular age and occupation groups of the population, but with some participants, problems stemmed from a general lack of familiarity with technology and access to the internet. They suggested that participatory on-line systems will become a useful means of facilitating access to data and planning tools as familiarity and access to technology improve.

PGIS allows managers and experts to incorporate public knowledge in their decisions. PGIS avoids expert decision-making that can be challenged for not incorporating local knowledge about local history and local relationships with places (McBride et al. 2016). One PGIS tool, called Mapping-Meaning (Map-Me), is an online mapping tool that has been used by the CSKT for decision making; it's Forestry Department uses the tool to identify differences between areas tribal resource managers and reservation residents believed prescribed fires should be used to manage forests. Map-Me allows the agency to gather local spatial knowledge that helped the agency make culturally sensitive

decisions (Sanchez 2017). A DSS provides a framework for integrating database management systems, with analytical models, a graphical display, and the knowledge that is gathered for the system (Densham 1991). This is different than a PGIS, which is a method for gathering public knowledge using a GIS in a participatory planning process. Relying on knowledge transmitted by reservation residents serves as an example of a PGIS approach of knowledge integration between forestry department officials and the public. A PGIS can produce collaborative networks designed to coordinate ideas and better address local and regional concerns (McBride et al. 2016).

Another example of a Decision Support System used to illustrate possible outcomes of policies made in urban development is CommunityViz. Salter et al. (2009) observed community planning workshops structured to provide participants with the opportunity to explore, discuss and assess residential density in a part of town that was of concern to local residents because of potential development. CommunityViz, an ArcGIS based decision support system made for interactive modeling and visualization of planning scenarios, was used to show the effects that policies have on development patterns. It is a tool to help communities understand the complexities of planning issues and make better decisions (Salter et al. 2009). This is a DSS that helps participants, who are municipal staff and individuals from the community at large, understand the effects that decisions may have on their community.

While a number of studies have applied PGIS approaches to ecosystem services and policy making (Carver et al. 2001; McBride et al. 2016), very few have used PGIS to assess people's well-being in different landscapes. Fagerholm et al. (2016) used a web-

based PGIS survey to examine the associations between the spatial distribution of "ecosystem services," and the nature of self-reported well-being. Ecosystem services in this instance, refers to outdoor areas that are used for recreation. The survey asked participants to map their home location and three recreation related indicators: 1) activities they engage in, 2) feeling and value, and 3) special place. A salient conclusion reached was that the contribution of landscape to well-being is largely related to values based on interactions among people and the landscape, tranquility/relaxation and people-people interactions such as being with family and friends. A following question concerns how can PGIS be used to improve sustainable recreation by increasing awareness of interest groups' well-being?

Collaborative Planning & PGIS

As a tool designed to engage participation and engagement in the collection, dissemination, and use of geospatial information in decision-making, PGIS is grounded in collaborative planning theory. Generally applied in the context of natural resources and/or environmental management, Margerum (2002) defines collaborative planning as an interactive process of consensus building and implementation using stakeholder and public involvement. The knowledge, values, beliefs, and experiences of stakeholders are able to be addressed, providing a foundation of information to use in the development of outcomes that stakeholders are able to relate to. Gray (1989) described the process of collaborative planning as being comprised of three phases: 1) a problem setting phase in which stakeholders become involved and a consensus is established, 2) a direction-setting phase in which the stakeholder group interacts in an effort to reach consensus, and 3) an

implementation phase in which stakeholders work to implement outcomes through individual and joint actions. When used correctly collaborative planning can be used as a process to address concerns by all stakeholders involved in the process.

The knowledge, values, beliefs and experiences of residents are more easily accommodated in the planning process using collaborative planning. When the process is fair and open, stakeholders can more easily accept as well as commit themselves to the outcomes of the process (Rantanen and Kahila 2009). Rantanen and Kahila (2009) note that the goal-setting phase should especially be collaborative as it is strongly affected by the set of values and ideas of each person involved. Authentic and personal dialogue between actors is necessary for "joining knowledge to action" (Rantanen and Kahila 2009).

To be effective, a DSS should have a close link between developers and stakeholders during the development process (Goodspeed et al. 2016). Therefore, designing a RDSS will require a collaborative process using PGIS methods where persons with local knowledge are provided opportunities to engage in dialog and shared learning to meaningfully shape a tool design. Arguing that expert-led design approaches often result in difficult-to-use technologies that focus on expert-identified needs, Goodspeed et al. (2016) have recently championed a design approach, "design thinking," that follows a five-step process centered on the needs and perspectives of users. The five stages of the design thinking process are: *empathize, define, ideate, prototype* and *test.* They applied this approach in a case study to create an ecosystem management (EM) tool called the Great Lakes Aquatic Habitat Explorer for a diverse group of specific stakeholders, by incorporating their knowledge into the design of the tool (Goodspeed et al. 2016). The de-

sign thinking approach produced an environment of collaborative learning among participants, which produced an EM tool that was useful for creating a tool for accessing information and analysis.

WebGIS

By the late 1960s and early 1970s various initiatives including Canada Geographic Information Systems (CGIS) and Urban and Regional Information Systems Association (URISA) created geographic or geospatial applications in automated cartography, the management of the census, and land-use planning (Goodchild 2005). Geographic information types in this era included representations of road networks, topography and land use. More recently, Goodchild (2011, 3) stated "it is fair to say that the leading GIS software products are capable of virtually any conceivable operation on any recognizable type of geographic information." In 1969 ESRI the most popular commercial GIS firm in the U.S., was founded by Jack and Laura Dangermond as a land-use planning research group. Since then, ESRI software packages including ArcInfo and ArcView were released, and the more accessible and broadly utilized ArcGIS 8 was released in 1999, providing an easy to use graphical user interface (GUI). Functions are constantly being added to this software platform that address the needs of specific disciplines and problems areas and to support a large number of forms of analysis, modeling, and visualization.

The way in which software is provided to customers is also changing. Service Oriented Architecture (SOA) is emerging as a new paradigm of computing in which tasks are performed by chaining together on-line services rather than by operations at the desktop (Goodchild 2011). For example, Google Earth Engine provides access to a multi-

petabyte catalog of satellite imagery to detect and map changes using the computing power of Google' servers. Also adopting a SOA framework, ESRI's online web GIS platform, ArcGIS Online, was released in 2012. Discussing ESRI's visions, strategic initiatives, and trending topics on ESRI's website, contributor Peters (2014) states "ArcGIS Online is building community relationships that change the way people work. ArcGIS [Online] provides a platform for collaborations, sharing, and community analysis that helps us better define and understand the world." In this fashion, new database and web technology standards are providing new opportunities to better manage and support user access to a rapidly growing volume of spatial information.

ESRI's ArcGIS Online is a complete, cloud based mapping platform, enabling a user to make and share maps over the internet. The ArcGIS Online platform is not the only platform available for creating an online map; other platforms include CartoDB™, iSpatial, Google Maps Engine, Mapbox™. These platforms are all similar to ArcGIS Online – all have certain limitations and advantages: ArcGIS and Google Maps Engine have the ability to be launched on mobile devices, CartoDB is an "easy to use" platform, ArcGIS Online allows the opportunity to turn visualizations into web services, and Mapbox lacks analysis tools found in ArcGIS online. ArcGIS Online is made for creating interactive web maps and apps, and comes with some of the analytical power and base maps found in ESRI's ArcMap, providing the necessary functions to create an interactive map.

WebGIS Design

While providing new opportunities and access to a growing volume of spatial information, the design, complexity and layout of interactive maps determines their effectiveness. An issue that is important to clarify is the distinction between analogue and digital cartographic representations and interactions. Roth and Harrower (2008) observe that multiple scholars within cartography consider analogue or paper maps to be interactive and thus potentially fall within the scope of a science of cartographic interaction. An important question addressed by these authors concerns how interactive maps can be designed in order to produce positive user experiences. They observed that interface complexity affects a user's experience of an interactive map, and note that the more constrictive an interactive map is (by limiting the functions available to users), the better experience a user has navigating and using the map. They assert that in order to create an interactive map that "wants to be used," the user must be placed front and center throughout the entire development process and gather input from them at all stages.

Dickman (2005) believes online maps are superior to the classic printed map for recreationalists arguing that internet-based maps more effectively transmit spatial information as part of an integrated visualization system than the classic analogue map. The main point of interest in Dickman's (2005) comparison was to determine the effectiveness of transfer of cartographic information, specifically that of relief and land use, attributes often encountered in the field of recreation. Two features required for an internet map are the effectiveness and efficiency of the transfer of information (Dickman 2005). To test the difference between the two types of maps, one group was given a web-based map and another an analogue map, and each was asked to retrieve information from

them. Despite limits in technology and the skill of the users, the digital map proved to be superior to conventional maps in answering questions.

What a map shows and offers to the map-reader is largely dependent on the author. Bosak et al. (2010) discuss one geotourism map in particular, the National Geographic Society's 'Crown of the Continent map guide.' Geotourism is a form of sustainable tourism, which is based on the notions of sustaining and enhancing the geographical character of place. Bosak et al. (2010) reveal how power, politics and subjectivity are involved in the creation of such a geotourist map guide. Though many maps and pamphlets have been made in Montana that help navigate the geotourist around the state to see the natural and cultural history of place, the authors contend that the National Geographic's map presents the user with tourism infrastructure/information that is socially constructed such that "…its representations of space are power-laden and have potential to create a place-myth for the crown of the continent that is not representative of the values of the people of the region" (Bosak 2010, 260). This study indicates that non-participatory approaches to map making are at risk of being steered by whatever interest is in charge.

While Bosak et al. (2010) discusses how maps are often created by groups of people that are influenced by self-interests and politics, Dragicevic and Balram (2004) discuss techniques to improve the decision-making process in planning by including stakeholders (i.e., collaborative planning). Two areas of concern and interest in the planning process are equity and access in relation to stakeholder inclusion and participation (Dragicevic et al. 2004). Equity deals with the fairness of representation in the planning pro-

cess, and access deals with the ability to make input towards defining meaningful outcomes. Web-based GIS frameworks should facilitate and integrate interest groups' knowledge into the planning process.

The Internet and mobile devices are allowing information to be obtained nearly anywhere. From what to see and do, how to get there, and where to have meals and stay overnight, the internet has increased end-user access to information about place. As discussed by Brown et al. (2013), web maps are able to convey up-to-date tourism information very well when designed simply and made to convey information interactively on request. The amount and quality of information in the map is important. A map that combines information about the landscape, such as terrain and tourist information, is a valuable travel companion to the tourist. Interactive web maps can offer more than resources such as travel agencies as they are able to serve as a personal tour guides in the car or otherwise.

One way of increasing visitors' positive experiences in a national park while protecting resources is by equipping them with information during their visits. Dye and Shaw (2005) present a GIS-based RDSS designed to help visitors of Great Smokey Mountain National Park choose and plan their activities more effectively by matching their personal preferences with constraints. Visitors often know what they would like to do during their visit, but often know little about the park beyond the most popular destinations (Dye and Shaw 2005). Visitors used this interactive map to match their interests and preferences with the opportunities available in the park. It allows the user to specify constraints (travel mode, trail difficulty, season, etc.), specify preferences and importance ratings (points of interest, park facilities, etc.), then presents the user with its results based

on their own criteria. The study demonstrated that this RDSS allowed users to make more informed decisions concerning what they wanted to see and do, therefore increasing their overall experience in the park.

Concluding Remarks

The content leading up to now has examined previous work pertaining to the methods and tools available which will aid in building a sustainable recreation decision support system using participatory GIS. The literature reviewed shows the efforts others have undertaken to make sure recreation does not affect communities in adverse ways. The review of participatory GIS literature has shown that by incorporating local knowledge into tools that will aid in decision-making, decisions will be likely to affect the public interest in a more positive way. Relying on the elements of sustainable recreation, collaborative planning, participatory GIS, and developments in WebGIS, the question of how to incorporate local knowledge into a sustainable RDSS is the focus of this research. The following sections will present the study area, the methods, and the results of this study.

Study Area

The study area for this project is restricted to Missoula County, Montana. The county provides a diverse set of recreation opportunities and is home to numerous groups (United States National Forest Service, CSKT, Missoula County, Montana Fish Wildlife and Parks, the Montana Wilderness Association, and Trout Unlimited, and others) that would have interest in sustainable recreation in particular areas or spaces. Its largest city, Missoula, provides access to trails and open spaces for recreation, and is home to the University of Montana. The surrounding landscapes provide opportunities to go mountain

climbing, rock climbing, hiking, fishing and many other activities. Around this major population center are other smaller communities, and the three largest land owners (the National Forest Service, the CSKT, Weyerhaeuser Corporation), offer an abundance of recreation opportunities (See Figure 1).

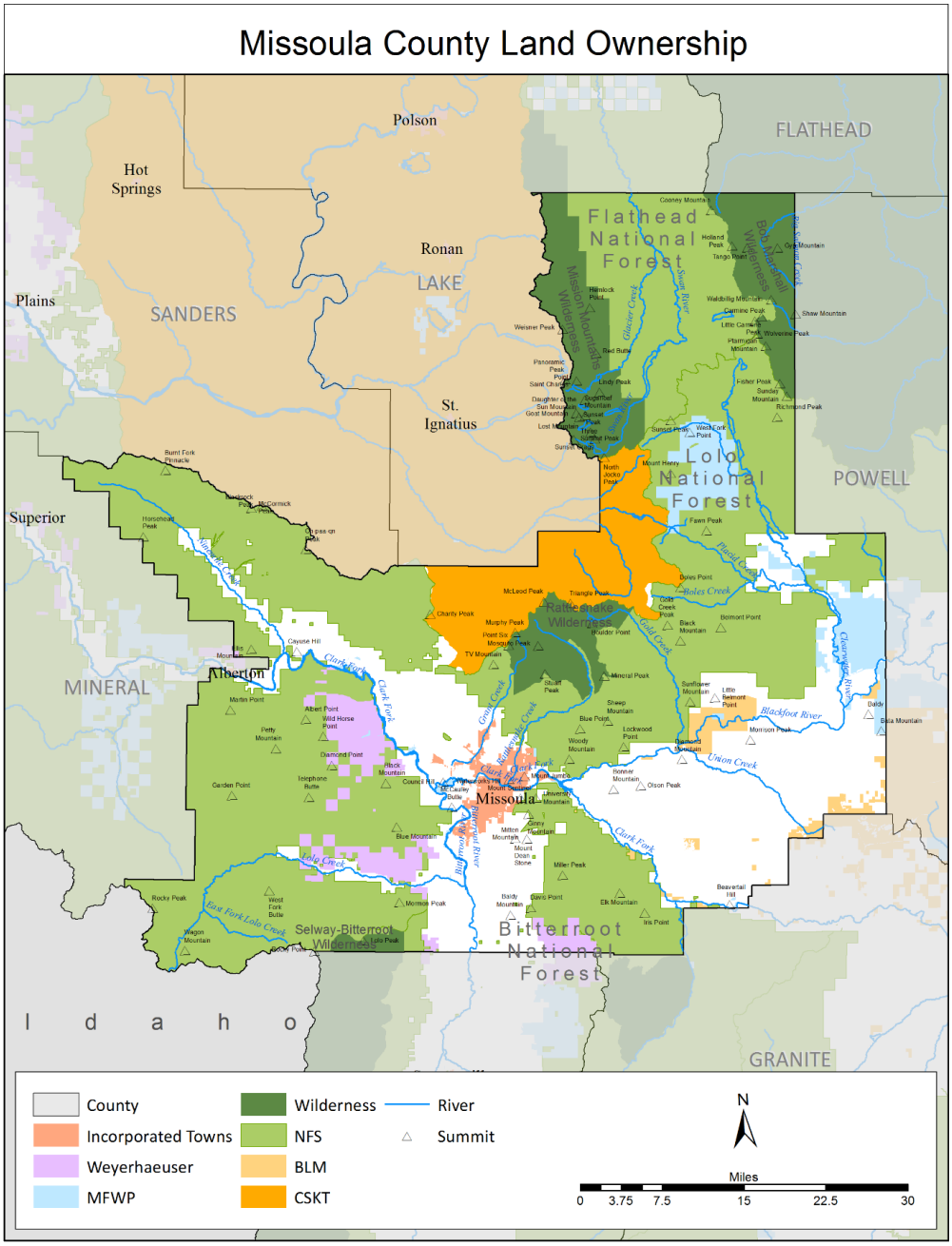

Figure 1: Missoula County Land Ownership (Sources of data: USDA 2016; Montana State Library 2016)

The size of Missoula County makes it a good starting point for this RDSS, which could eventually encompass other counties or be applied in other states. The county is 2,618 square miles in area, has a population of 114,181, and a population density of 43.61 people per square mile (United States Census Bureau 2015). The City of Missoula adopted the Missoula Growth Policy in November 2015 with the intent to make Missoula an "…ecologically sustainable community, with accepting attitudes and an accepting economy" (City of Missoula 2015, 9). Additionally, the County of Missoula's Growth Policy is organized in three main themes Landscape, Livelihoods, and Community (Missoula County 2016). This shows how the culture of this area is intertwined with the landscape. As outlined in this plan, the people and landscapes of Missoula County are key to a vibrant and successful community. It is assumed that using local knowledge to build a RDSS will help promote sustainable recreation activities and facilitate Missoula County's inclusiveness of all groups and interests.

Found in the area is a wide array of recreation activities and the use of public lands for recreation is above average. It is estimated that 1,401,000 visitors enter Lolo National Forest to participate in recreation activities every year for recreation compared to 361,000 visitors who enter the Lewis and Clark National Forest to participate in recreation activities (USDA 2015). It is also estimated that 62.8 percent of visitors to national forests travel within 50 miles of their home for a visit to the forest (USDA 2015). The strong recreation ethic exhibited in the county, its mix of public and private lands for recreation, and presence of interest groups with concerns about sustainable recreation, make Missoula County an excellent study area for this research.

Methodological Approach

This study on how to incorporate local representatives' knowledge into a RDSS used a mixed methods approach relying on a collaborative focus group for content scoping and WebGIS design. The study area and the area that this tool is developed for is Missoula County, MT. As noted above, Missoula County offers a wide range of recreation opportunities and a diverse set of stakeholders who may have an interest in being invlolved in the design process of a RDSS. The central location of the city of Missoula, and the range of stakeholders that have offices in Missoula or reside on the University of Montana's (UM) campus, made it a good location to hold a focus group meeting. The focus group meeting took place at the Social Science Research Laboratory (SSRL) on the UM campus, during the 2017 spring semester. The SSRL offers the necessary resources for group engagement and mapping activities for conducting the focus group for this study.

The methodology adopts a user centered WebGIS design framework proposed by Tsou and Curran (2008) which consists of five major components: 1) the strategy stage, 2) design of the spatial database, 3) the design and population of web map database, 4) the design of map browsers, and 5) evaluate the context of web map use (Figure 2). This approach also includes observing and documenting the participation process, particularly how people participate individually and collectively, what they recommend for resources and data sets, how they envision these resources being presented for best use, and their evaluation of the tool.

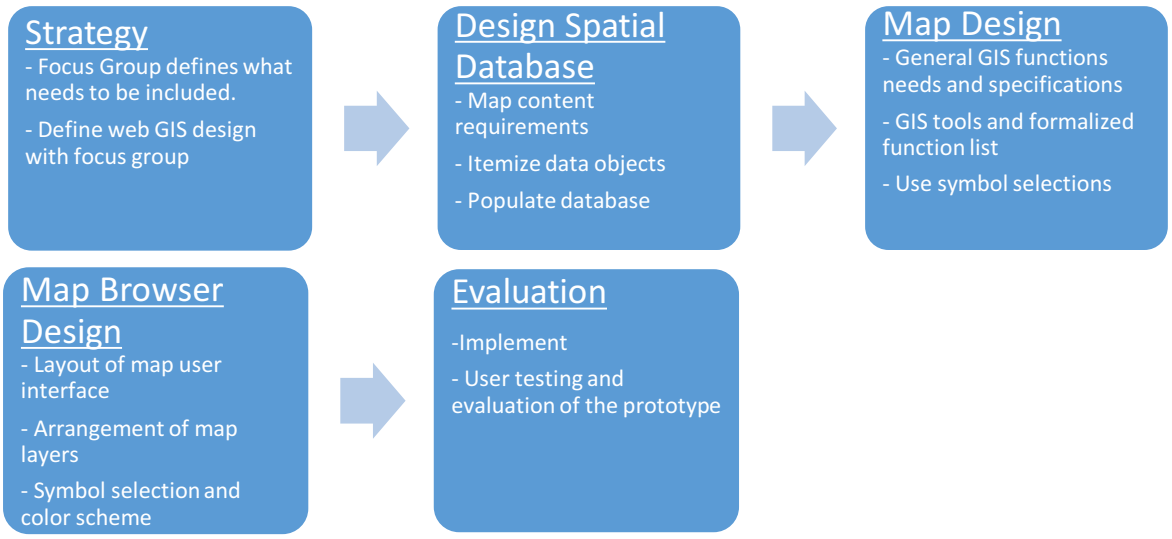

Figure 2: Diagram of the development and evaluation process used to create the Web application

Step One: Strategy

At the beginning of the Strategy stage, two items were specified: user needs and map service objectives. These are basically the content and the design of the Web GIS map. In this case study, the user needs and mapping objectives have been determined by the focus group. The focus group was comprised of seven representatives recruited from various groups who have interests in the public lands and waters used for recreation in Missoula County including University of Montana student recreation groups, local recreation groups, local natural resource advocacy groups, and conservation groups. Group/representative characteristics are listed in Table 1.

Table 1: Participating Interest Groups

Focus Group Number	Represented Group
FG01	Local trail runner and Five Valleys Land Trust
FG02	The Clark Fork Coalition
FG03	Student Recreation Association
FG04	The Blackfoot Challenge
FG05	UM Wilderness Association
FG06	University of Montana Student Nordic Ski Club
FG07	Montana Wilderness Association

A focus group was used because it helped foster a "synergistic group effect," which is described by Berg (2004, 127) as the "interactions among and between group members [that] stimulate discussions in which one group member reacts to comments made by another." This synergy allowed participants to draw from one another and brain-storm collectively with other members of the group to determine how to best design, and what to include in, a RDSS. In order that the focus group ran smoothly and to encourage synergy, some basic elements which Berg (2004) pointed to as "essential elements" or in-gredients required for focus group interviews were adopted for this study:

1. A clearly defined objective and/or research problem – the guiding research question is how to incorporate local representatives' knowledge into a tool such as an interactive map/RDSS.

2. The nature of the group – the focus group will include members from groups who hike, climb mountains, fish, mountain bike, have in interest in land and

wilderness conservation, and have interest in culturally significant areas.

3. Atmosphere/environment and rapport – insure the focus group session is in a comfortable environment and make sure participants are aware their opinions are safe and confidential.

4. An aware facilitator – have a schedule/agenda prepared, but also be flexible and allow for following questions that arise

5. A well-organized and prepared facilitator – make sure facilitator is well trained and a clear understanding about how things will proceed.

6. Structure and direction – the facilitator will guide the discussion, avoid offering opinion and substantive comments.

7. Research assistance – video record the focus group session.

8. Systematic analysis – analyze the data using systematic means.

The facilitator used a guiding document, adapted from Greenbaum (1998) for conducting research with a focus group (see Focus Group Guide #1 in Appendix A). This helped the group feel that it was driven by a purpose and task that is real, practical, and shared by the group, which produced creative and effective feedback for the production of a WebGIS RDSS. The group considered a series of questions from the guiding document and were asked to draw (annotate) on maps the areas that their group finds to be significant, and to provide information about the attributes of those areas and recreation behaviors appropriate within them. Each participant took turns drawing on the map and answering questions from the Focus Group Guide #1. After a participant answered a question, fellow participants were allowed to give feedback and discuss answers with the group.

Features of the interactive map itself were also discussed in the focus group, including: (A) map content requirements, (B) itemized data objects, (C) GIS tools/ functions, (D) the layout of map user interface, (E) arrangement of map layers, and (F) symbol selection and color schemes. The audio, worksheets, and the map used to draw on during the focus group were used to identify themes and content for the sustainable RDSS. Additionally, exemplary content will be provided in the results sections showing pertinent information and ideas the participants provided. The identities of participants are protected using the Focus Group numbers, provided in Table 1 above, as identifiers.

Step Two: Design a Spatial Database

After the focus group session, notes and transcriptions of the video recordings of the session were reviewed. Transcription, open coding and content analysis (see next section for more discussion of this analytical method) was used to identify desired database elements, their desired characteristics, particular concerns about the representation of sensitive information, and interactions among the participants. In this stage, inferences where made by systematically and objectively identifying explicit or manifest themes within the notes and transcripts. Any implicit or latent themes present in the data were also documented.

This step was used to start organizing a spatial database and creating a conceptual design of the WebGIS. The map content requirements were identified from the themes that emerged during content analysis. This step focused on map content (what information and data were to be included in the map), and the identification of areas and information participants know about them and what they would want to inform others about.

The procedure included gathering and organizing the map content requirements (A) and the itemization of data objects (B).

Table 2: Data Categories and layers identified to include in RD

Data Category	Data Layers
Basemap	Ownership
	Roads
	Topography
Recreation	Recreation Points
	Recreation Areas
	Trails
Indicated Areas of Value	City/County Open Spaces
	Intact Roadless Areas
	Rivers
	Areas of Conservation

A list of data was then made that needed to be included in the RDSS and can be seen in Table 2. Itemizing the data included putting the data into themes that included: recreation sites, recreation areas, areas of interest, and links to websites that were identified during the focus group discussion. The data that were used for this map were obtained from the FSGeodata Clearinghouse (data.fs.usda.gov/geodata), Montana State Library Geographic Information Clearinghouse (geoinfo.msl.mt.gov), MapBox (mapbox.com), and from digitizing areas of interest participants identified during the discussion.

Step Three: The Design of the Web Map

The next step involved the design of a RDSS based on expressed user interests and needs using ESRI's ArcGIS Online platform. During this process notes were made of

any discrepancies between focus group expectations and the capabilities and constraints posed by the ArcGIS Online platform. The design and implementation of this interactive map focused on the general need for GIS tools and functions (C) provided by the selected web map servers.

The tools identified by the focus group and during the content analysis were identified, and those that were able to be included in the RDSS were constrained to the capabilities of ArcGIS Online and the experience and resources at hand to the cartographer. All the tools that were used in the RDSS are widgets that are offered by ESRI's ArcGIS Online Application Builder.

Step Four: The Design of the Map Browser

The next step involved the design of the map browser and the display of map layers for this interactive map, using the ArcGIS Online platform and incorporating knowledge the focus group provided. The procedures include (D) layout of map user interface, (E) arrangement of map layers, and (F) symbol selection and color schemes. This step used ESRI's ArcGIS Online platform.

Step Five: Evaluate ArcGIS Online RDSS

The last step was to evaluate the RDSS. The target users of this RDSS are any persons wanting to find a place to recreate, but the information that is intended to be conveyed is from the interest groups' knowledge. Therefore, the prototype was evaluated by the focus group participants. The user testing and evaluation of a prototype is an excellent way to determine the usefulness and functionality of a new system or application (Shneiderman 1998; Tsou and Curran 2008). For the evaluation process, focus group participants developed and completed a task using the newly designed RDSS interactive map,

and filled out a questionnaire (including structured questions) about their experiences using the RDSS interactive map (see Focus Group RDSS Evaluation Form in Appendix B). This evaluation was completed at their residences, or elsewhere, using the prototype interactive map that had been published to the internet (accessible only to focus group members and the investigator).

The questionnaire was created using the survey tool Qualtrics and was divided into five sections (See Focus Group RDSS Evaluation and Discussion Form in Appendix B). In the first four sections, participants rated the prototype interface, the tools, data layers, and map display. The fifth section of the questionnaire is composed of short answer type questions that address overall impression of the design, information content, performance, usefulness, and the use of ArcGIS Online as a means for a RDSS. After analyzing the evaluations for the interactive map, changes were made to the interactive map.

Content Analysis

This research employed a collaborative focus group and qualitative social science research approach in which focus group participants work collectively to brainstorm on what they want to see included in a RDSS for sustainable recreation. Working in a collaborative setting produced rich qualitative data suitable for content analysis (Berg 2004) so that important themes concerning RDSS design and content might be identified. Video and notes taken during the focus group session were reviewed and transcribed. Open coding was used to identify: desired database elements, their desired characteristics, particular concerns about the representation of sensitive information, how representatives prefer areas their group regards as significant to be included and/or depicted, information about the attributes of those areas and recreation behaviors appropriate within them, tools and

functions that would help to inform users of these behaviors, and interactions among the participants. Open coding is described by Berg (2004, 281) as an "unrestricted coding of the data." Open coding involved careful and detailed reading of content, line by line and word by word, to identify any concepts and categories inherent in the data. After open coding was completed, content analysis began.

After open coding was used to establish grounded categories, the next stage was to analyze the content. Berg (2004, 286) recommends in this stage to sort the data accordingly into the words and themes identified by open coding; this includes manifest content that is explicitly suggested by the questions considered by focus group participants, and latent content that might emerge more organically. For this study, NVivo software was used for this qualitative analysis. This program specializes in locating every instance of a specific word, phrase or character string, to identify, attribute, count, and analyze words and themes embedded in the focus group content. Themes and categories of themes, and interactions between them, can then be identified. Berg (2004, 287) observes that the frequent emergence of themes in a particular category from different subjects or cases does suggest to the researcher where to look for patterns. A common rule of thumb he recommends following is that a minimum of three occurrences of something can be considered a pattern.

The content analysis process started by looking for the manifest or anticipated themes that would appear from the focus group session. After these manifest themes were identified, latent themes started to emerge. Once the thematic patterns were identified, the next step was to understand and explain their meanings for sustainable recreation and

PGIS. The following will discuss how the focus group drove the design and content of the RDSS.

Results

The objectives of this study are focused on PGIS, RDSS design, and sustainable recreation. It explores how effective the PGIS method is to create such a sustainable RDSS for a community using participants from a diverse set of interest groups, what content these groups want to see included in an interactive map to make recreation activities more sustainable for a community, and how well an interactive map developed using ArcGIS Online is able to incorporate the ideas from participants and function as a sustainable RDSS.

Overall, the RDSS development process was new for most participants, and the project of creating a recreation map that promotes sustainable recreation resulted in positive feedback from participants. The results for this study are organized in four main areas: the focus group discussion, indicated recreation values, how these ideas should be incorporated into an interactive recreation map, the utility of an interactive map as a RDSS and how it might work as a sustainable recreation tool. After the results are discussed, a brief description of the resulting tool will be presented at the end of this section.

The Focus Group

Having focus group participants that were knowledgeable about the area participate in this study enabled it to address values from the perspectives of their organizations as well as from the larger community. The focus group brainstormed ideas and discussed what should be included into a sustainable recreation map, the recreation map was built using their ideas, and the same participants were then sought out to give feedback on the

prototype. Overall, participants seemed to have enjoyed the opportunity to engage in the focus group process, providing information concerning areas of significance and why they value these areas.

The participants where given the option to either discuss areas of interest with the entire group around a hardcopy map or individually using an online mapping/survey tool, called Mapping Meanings, to delineate areas of interest and ideas for the map. The group decided to work together and converged around a 33-inch by 44-inch map of Missoula County annotated with public lands and recreation features. The participants took turns discussing areas that are significant to them, why they value these areas, what information would promote more sustainable activities, and how this should be represented in a web map. Feedback from other participants about how they value these areas and what recreation behaviors are most acceptable was often provided and was well received.

Additionally, given that Missoula and its county are modestly sized communities, many of the participants knew each other from community events and by working together on projects with their respective interest groups. They were all pleased to take part in the project, and were curious about the audience this would capture. Initially, some of the participants were hesitant to participate, concerned that their personal values may not always be representative of their organization. This concern was addressed by assuring the representatives that their identities would not be mentioned in the RDSS and that ideas provided during the discussion could be as general as they felt comfortable with.

The focus group participants indicated that the map served to provide a synoptic view of the county and all of the opportunities that are found in it. The participants were ready to start marking their favorite places on the map and sharing with others why they

enjoyed these special areas. There was little warm up needed for the participants to share with the group. Many of the participants mentioned that they enjoy looking at hardcopy maps and the only time they use hardcopy maps is when they are on a backpacking trip. At the end of the focus group session one participant mentioned "I wish we could do this more often" (FG04).

The themes and the frequency in which the identified content from the focus group were discussed are presented in Table 3. Throughout the discussion, one theme repeatedly emerged from the group. By informing visitors of what local people value about the area (e.g., the natural history, wildlife, and the health of natural resources), this would in turn would instill a sense of connection or respect for the area leading to more respectful decisions and more sustainable activities.

Identified Map Content

This section summarizes the major themes that emerged from each question. Table 3 shows the themes which emerged from content analysis. Examples of responses from focus group members that address these themes are provided in Appendix C.

Question 1: Areas of Significance

As a representative of a larger group locate what areas are significant or important to your group? Each participant identified different areas as being significant to the group or organization they are associated with; these are shown in Figure 3. Each color on the map represents a different participant. Having varying interests, distinct differences in areas significant to different participants are evident on the map, while some areas overlaid with others. This can be seen by looking at the areas that FG07 highlighted and FG02 highlighted. FG07 was representing the Montana Wilderness Association and

Table 3: Focus Group Content Analysis: Frequency of themes that were discussed during the focus group.

Theme	Frequency
Most Acceptable Activities	
River Activities	11
Skiing	11
Hiking	9
Backcountry Skiing	3
Wildlife Viewing	3
Camping	2
Tribal Recreation	2
Biking	1
Horse Riding	1
Nature Viewing	1
Not Acceptable	
Dogs	5
Hiking	4
River Activities	2
Snowmobile	2
Camping	1
Bike	1
Awareness	
Regulations	18
Wildlife	17
History	16
Recreation Awareness	12
Infrastructure	11
Map Design	
Layers	12
Links	10
Icons	5
Value	
Accessibility	22
Community	19
Wildlife	17
Conservation	13
Scenery	9
Wilderness	9
Social Gains	6
Education	4
Agriculture	3

highlighted all the Wilderness and Roadless Areas where the landscape was mostly mountainous, and FG02 was representing the Clark Fork Coalition and highlighted areas mostly around rivers. A few participants noticed this as well and described them as different types of "recreation corridors." Recreation corridors being areas where different recreation activities occurred. In the areas that overlaid with another area, the participants generally collaborated in designating those areas of importance. In general, the areas identified could be split into the river corridors, open spaces or high density urban use corridors, mountainous corridors, wilderness and intact roadless areas.

Areas around the edge of Missoula are known for their highly accessible recreation opportunities, and two participants were mostly interested in the trails around the perimeter of Missoula. One participant was a part of a student recreation club, interested in bringing students with recreation interests together, and the other was active in the running community and helped organizing trail running races around Missoula. The areas were mostly chosen for their accessibility and quick escape from the city into a "wilderness" area (see (i) in Appendix C).

Other areas of interest that two of the participants focused on were different stretches of the rivers that flow through Missoula County. These two participants were involved with river conservation and healthy river awareness groups in Missoula County. The entire Blackfoot river was indicated as being an area of value, along with the section of the Clark Fork River that runs through town, and additionally areas that have received conservation attention to restore the Clark Fork River's health such as the Milltown Dam site and the Alberton Gorge area. Additionally, participants enjoy the

Figure 3: Map of Missoula County used by participants to locate areas of significance. Each participant had a different color marker to draw with.

Clark Fork because it is managed as a non-motorized river, adding to its tranquility and escape from the noise of the city (see (ii) in Appendix C).

Another indicated area of significance that came from the focus group discussion related to areas for skiing. The discussion of these areas were started by a participant who came from a student Nordic skiing club. Areas that were indicated included Lolo Pass, Pattee Canyon, the main trail in the Rattlesnake Recreation Area, Lubrecht Experimental Forest. Additionally, every participant in the focus group enjoyed skiing and had their favorite place to go skiing. Some of the participants mentioned them and others preferred not to share their special areas. Additional places that were identified from this conversation were any Forest Service Road (especially ones near Lolo Pass and in the Seeley Valley) and backcountry places, such as the back side of Snowbowl Ski Area and the Wisher Ridge Area.

Additionally, wilderness and intact roadless areas throughout the county were identified. These were again identified by two participants of the focus group involved with wilderness oriented awareness and advocacy. These areas were significant to these participants for their remoteness from human development and lack of roads (see (iii) in Appendix C). Other participants of the focus group valued the same things about these places.

Question 2: What Participants Value

Generally, describe what your group values about this area. Throughout the focus group process, certain manifest themes emerged from the group conversation. The themes that frequently emerged had to do with how the participants valued recreation ar-

eas they located on the map. These themes are represented in Table 1. The most commonly occurring themes in order of greatest frequency will be discussed below and include:

1. *Accessibility*
2. *Community and Conservation*
3. *Wildlife*
4. *Wilderness.*

Although participants represent different types of groups (recreation, conservation, and advocacy), they valued a lot of the same things about the areas they delineated. Additionally, regulations were frequently discussed in the focus group session and so will be presented and discussed throughout the discussion below. What did vary, though, was where the use of motorized vehicles should or shouldn't be allowed. This will be discussed more thoroughly in the Discussion section.

Accessibility was an important theme that came up during the conversation. This is a latent theme, as accessibility was never explicitly asked about. As noted above, the community of Missoula has many open space areas protected from development around the city. These areas have been conserved to protect wildlife habitat and provide recreation opportunities for the community. For instance, Mount Jumbo is right on the edge of the City of Missoula and is protected from development. It has many trails created and used for recreation and closed seasonally so that an elk herd can uses its slopes as winter habitat. Discussed in the session was the accessibility of recreation areas and how many of them are easy to get to from the city of Missoula. A participant interested in Nordic skiing expressed that they enjoyed Pattee Canyon skiing area next to the community of

Missoula for its close proximity to the community of Missoula and for its diversity to accommodate skiers of all levels (see (iv) in Appendix C).

Two manifest themes the group found important to include are the strength of the *community* and how it (the community) is willing to set aside land for *conservation*. One participant states "There's just all this habitat beyond just the human uses of it is really cool. That it can be as close as it is to town and we have this restraint to not be there for a few months a year which is really cool (FG01)." Another participant stated "There are so many areas of conservation in this community that defines our landscape (FG02)." This is the type of content, how the community values its recreation areas and the history of the area, that the group thought is necessary to inform others about because it creates a feeling of investment in the area; this is a feeling that many of the participants said they felt when they first moved to the area. Creating this feeling and attitude in the users will help influence them to make respectful decisions, such as following general rules of trail use, when using these special areas participants indicated.

The themes discussed above; accessibility, community and conservation, blend into a larger manifest theme of *wildlife* that extends further from the city. The value of wildlife habitat and diversity was mentioned for many areas on the map, including areas adjacent to the city of Missoula and more remote places in the County. Talking about an area in the Seeley-Swan Valley, one participant said that it had "Amazing wildlife values, some of the best grizzly habitat in the lower 48, throughout this neck of the woods, but just in the next months all these valleys west facing will fill up with grizzly bears. So, some of these areas outside of the wilderness are the most valuable habitat (FG07)."

The manifest theme *wilderness* was brought up by every participant as to why they value the indicated areas. Not only was designated wilderness discussed by each participant, but the feeling of being in wilderness. One participant mentioned that they enjoyed the trails outside of Missoula for the feeling of wilderness right outside of the city's limits. These areas are present across Missoula County, they include the Intact Roadless Areas on USFS land and the open spaces around the City of Missoula. One participant noted the uniqueness of these areas to the community and how the community is "lucky to have quite a few of those areas in Missoula County (FG07)."

Question 3: Most Acceptable Behaviors

What recreation behaviors are most acceptable within these areas? After identifying areas of significance on the map and providing some information as to why they are significant, participants provided insight into what recreation behaviors are most acceptable in them. Discussion focused on how participants can engage in recreation activities that are respectful of what the community values. Table 1 shows that *skiing, river activities, and hiking* were activities that were mentioned with the greatest frequency. Content concerning acceptable behaviors often was directly linked to unacceptable activities and so that content will be presented in its entirety in this section.

Skiing includes both backcountry skiing and Nordic skiing. The areas where participants enjoy skiing the most are in areas where ski trails are groomed, on any National Forest Service Road, and few participants expressed interest in backcountry skiing. Surprisingly, skiing at the Snow Bowl was only mentioned once. The representative from a Nordic ski group indicated that activities that are most acceptable in ski areas include

having your dog only in designated areas such as in Lubrecht Experimental Forest, staying in Nordic ski tracks on the groomed trail to preserve them for other users, and pack-it-in/pack-it-out practices for anything skiers bring with them. Focus group participant FG06 mentioned that they had worked in the Lolo Pass Visitor Center and said that in order to find out what activities are most acceptable, the best way is to look at the Forest Service Regulations. On the topic of whether certain activities should be allowed, opinions really came out when the use of snowmobiles in designated areas on Lolo Pass was mentioned. In this discussion, three participants mentioned how they did not believe snowmobile use is an acceptable form of recreation at Lolo Pass. One participant, FG07, stated that they find the Lolo Pass area a nice place to go skiing, but will not go cross-country skiing at Lolo pass for the reason of snowmobiling and the noise, unless it's really early season in early December. Some disagreeing views played out in a conversation between participants:

> FG06: If we could only ban snowmobiles.
>
> FG07: I'm with (FG06) on that one.
>
> FG02: Me too.
>
> FG01: No way they're too much fun.
>
> FG06: I find it incredibly disconcerting when I'm out skiing in a pristine wilderness and I hear the buzzing of a snowmobile.
>
> FG07: Actually, I won't go cross-country skiing at Lolo pass for that reason, unless it's really early season in early December or something.

The theme *river activities* was also mentioned with great frequency. There were two participants who are involved with either river conservation or advocacy in Missoula County. They gave great insight into what activities are most acceptable on the river. The

activities that are most acceptable when on any rivers include following state fishing regulations, using established fishing access points, most importantly knowing about hoot-owl restrictions in the summer and using non-felt waders to prevent transporting invasive species. The Blackfoot River was valued for its notoriety, and so respecting it is very important to the culture of the area – as one participant put it "It's the god damn River Runs Through It…It's a blue ribbon trout stream, it has incredible scenic values, people. It has bull trout, an endangered species." Particularly for the Blackfoot River, being aware of the presence of bull trout and not targeting them and releasing them as quickly as possible if caught while fishing, was mentioned as being important. Also mentioned for all rivers, and not necessarily identified areas of significance, was to respect their health and the health of the river banks and riparian areas, such as using designated river access sites to prevent stream bank erosion and leaving no trace (see (v) in Appendix C).

Hiking emerged as an activity that all participants enjoy. Most acceptable hiking includes leaving no trace (LNT), staying on the trail, not picking wildflowers, and basic hiker etiquette. Hiking was indicated as a low impact recreation activity when the public is following proper hiking etiquette.

Question 4: Promoting Sustainable Activities

What information would you like to provide to others about these areas to help sustain the health of the environment, community or cultures? The focus group discussed what would be beneficial to have someone learn about in order to make respectful choices and become more aware of the community they are recreating in. The themes presented here are all latent with the exception of recreation awareness as none of them, other than recreation awareness, were specifically asked about. The five themes that were

identified from this discussion, ordered based on consensus regarding their importance, include:

1. *Regulations*
2. *Infrastructure*
3. *History (natural and cultural)*
4. *Recreation Awareness*
5. *Wildlife*

An expected theme for a recreation map that was discussed was around the topic of *regulations*. There are many recreation areas in Missoula that have different regulations. Many of these regulations already help to sustain the health of the environment and a person's experience in a particular place. So including these important regulations is important. There are regulations, which participants thought were more important to include. One participant stated "I think something like, in terms of regulations, to be aware once water temperatures are over 68 there are restrictions on fishing hours, so that's really important for people to know." Other important regulations that were mentioned as important included Montana stream access regulations, making sure to stop at boat inspection stations, and where dogs are and are not allowed in public recreation areas. The focus group session allowed for more of these important or themes relevant to the area to be identified and included in the RDSS that otherwise may have been missed or lost if PGIS and local knowledge was not used to create this RDSS.

Another latent theme mentioned throughout the discussion was *infrastructure* – the things (e.g., forest service roads, trails, camping areas, and also facilities such as bathrooms and RV dump stations) that have been built and maintained for visitors of public

recreation areas to use. Participants valued these things because they help ensure that these areas are used in a sustainable way (see (vi) in Appendix C). Infrastructure helps to concentrate use into certain areas and provides engineered ways to prevent things like erosion, and degradation of the surrounding environment.

History. Participants agreed that providing information concerning the history of the area would help promote sustainable recreation activities. There were three types or categories of history participants focused on: conservation history, natural history, and the history of Native Americans in the area. One participant (FG01) summed it up nicely "I'm interested in all of it, you know I would love to see a regulations layer, the history, layer, the natural history layer, the cultural history layer, I mean it's too much, but it's interesting to think about how that can be integrated into a map in a sharp way, the technology is there (FG01)." Many of the participants nodded in agreement with this statement that by providing historical information a RDSS can instill a sense of respect for the area.

Recreation awareness is knowing what activities one could expect in a particular area. One example given was "…so say you're a hiker who avoids heavy cyclist activity, then we should include a layer that is not including a lot of the heavy cycle trails...or if you're looking at one specific trail then you want to see other uses you should expect on that trail as well (FG05)." This would prevent conflicts, such as between cyclists and hikers, from occurring in the first place. It would help to find trails in which a hiker could avoid bikers and help bikers find the trails with activities which do not disturb their activity. Other examples that were given addressed knowing where you could expect to see dogs on the trail or knowing where skate skiers tend to go so as not to impact any two

tracks trails created by traditional kick-and-glide Nordic skiers. Being aware of these activities that are most appropriate in an area would help reduce user conflict.

Wildlife was of strong importance to everyone in the group and something that the participants want to make the public aware of to make better recreational choices. Specific examples included the elk winter range on Mount Jumbo, and springtime grizzly habitat on the southwest facing slopes along the Seeley-Swan Valley, and being bear aware. Providing information to recreation users about wildlife will help them respect animals that are iconic to the area.

Question 5: Map Design

What tools and functions would be helpful to include in a RDSS to help inform users about the importance an area has? Three themes concerning RDSS tools and functionality emerged as being the most important. *Layers, icons pop-ups, and queries* were identified as adequate ways to inform users of the recreation opportunities in the area, find recreation areas of interest, and to relay additional indicated content.

How they should be leveraged to be most effective was also discussed; the conclusion was to represent specified recreation areas using a polygon *layer*, presenting the most important regulations at recreation points (icons). These representations will be used to provide historical context, what recreation activities to expect in an area, and provide historical context for an area all using pop-ups when the user clicks on an area of interest. The information in the base map was also discussed and what it should show. Participants thought that it should include topography, roads, and land ownership. These features were thought to be necessary to gather important information from the map and to help make recreation decisions.

Using a polygon layer was thought to be adequate to represent all the recreation areas and areas that have significant natural and/or cultural histories. These are the areas which the participants indicated on the map during the focus group session. Participants recognized that the possibilities of what can be included are endless (see (vii) in Appendix C). The content which the focus group thought would best promote sustainable activities included conservation history, natural history and cultural history. The pop-ups that appear when a user clicks on the recreation areas will provide brief introductions to these recreation areas, while recreation sites, such as trail heads, fishing access points, boat launch sites will be represent by icons at the specific site.

The focus group thought *icons* could serve a couple of different purposes. Icons could show specific recreation sites, and the *pop-up* associated with them would then show what activities are allowed at the site, any important regulations, and would provide links to agencies' (that manage areas in which sites is located) web pages where more detailed information is located. Also mentioned were links to other websites, such as the Missoula Nordic Ski Club or Montana Wilderness Association for more information. Local websites like these were described as "great resources" to provide additional information about local recreation opportunities. The participants thought it would be important to present information succinctly via the pop-up and links to prevent the user from being overwhelmed.

Resulting RDSS

The resulting RDSS developed using the focus group outcomes is shown in Figure 4 and is summarized in Table 2. It contains several functions and layers that should

help to promote sustainable recreation. The RDSS is structured by three major elements: the *base map* showing information that aides users in gaining familiarity with depicted areas, *base layers* where users can obtain information about areas and sites of interest such as the topography and roads, and the *tools* which let users interact with the map (i.e., basic navigation and exploration, querying, and acquiring information about areas and sites of interest).

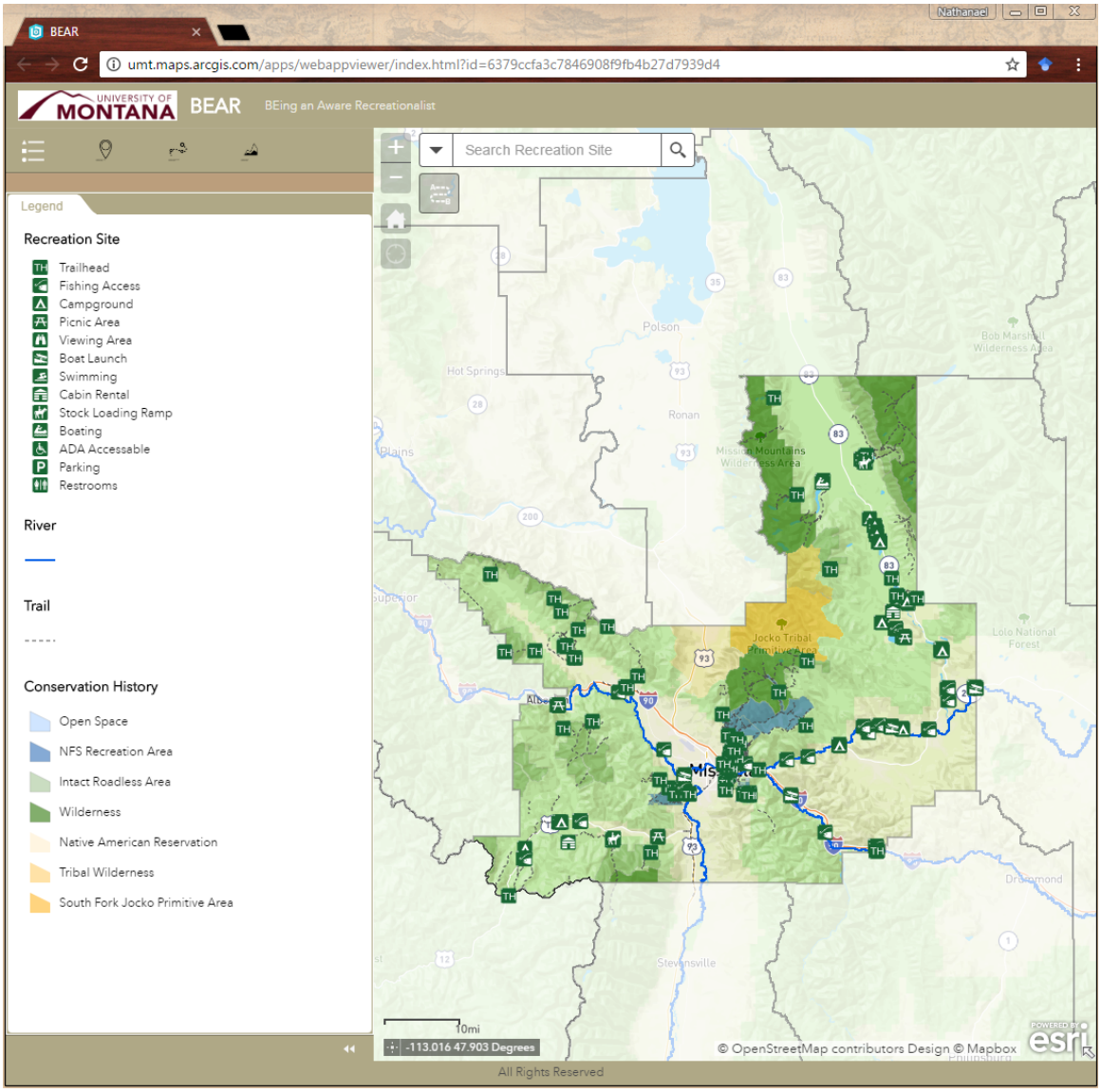

Figure 4: The Sustainable Recreation Decision Support System interface.

ArcGIS Online provides basic *base map* templates to use, but also allows the cartographer to build a base map in a second party software and incorporate it into the ArcGIS Online web map. The base map used in this project was adopted from Mapbox and customized to reflect the features the focus group identified that should be included in the basemap. The basemap from Mapbox was included because the topography, roads, and land ownership better reflected what the participants were looking for. It was included in AGOL by adding a URL provided by Mapbox to AGOL. The basemap from Mapbox includes layers that recreationalists should find useful when searching for areas and locations to visit. Base map layers include land ownership, management types (National Forest Service, State of Montana), roads, and contours (10-meter interval) with hill shading. These layers were identified as being essential for a recreation map by the focus group, allowing the user to gather some basic information from the map at first glance. For example, the user can acquire directions to a particular site or determine the topography of an area of interest to help inform decision making.

The operational layers, or *base layers*, in the RDSS contain the content that makes it a "recreation map." This would include a recreation sites layer with information on trailheads, trails, fishing access locations, and the different types of recreation areas. This content was retrieved from Lolo and Flathead National Forest databases and the Montana State Library. Information about these areas was added based on the outcomes from the focus group, such as what activities are most acceptable in an area, and any regulations for using the area. Additionally, there is a conservation history layer which was identified as being important to include from the focus groups session and was retrieved from the internet.

The map also contains tools such as *queries* and the *search tool* to help users find recreation areas, and pan and zoom tools to help in exploring and/or navigating the map. These are provided as defaults in the ArcGIS Online application template. Additional tools that the focus group identified are the recreation activity query, user location, and the directions tool, all of which have been added to the RDSS.

RDSS Evaluation

All of the content and tools the focus group wanted to see included in the sustainable RDSS was able to be incorporated into it. The prototype RDSS was then evaluated by the focus group participants for its utility as a sustainable RDSS. The results of the survey are summarized in Table 3 in Appendix D. All of the participants from the focus group were sent a survey and 4 of the 7 provided a response. There was a lot of positive feedback on the RDSS. The main purpose of the evaluation of the RDSS tool was to see how well participants thought their knowledge was incorporated into the RDSS, how well it conveyed that information, and how useful they thought the RDSS would be for promoting sustainable recreation activities. Additionally, the evaluation was used to see if anything was missing and to identify any areas requiring improvement. Participants were given a link to the RDSS, which was published online, and a link to the survey constructed in Qualtrics™, a software available for use at the University of Montana. The participants were given as much time as needed to familiarize themselves with the map and answer the survey questions. Participants gave high marks for the multiple choice evaluation questions concerning the interface, map display, tools, data layer, and usefulness (see Appendix D). The RDSS received very strong feedback for its cartographic elements and scored the lowest on providing enough information to guide decision making

on where to recreate (see Appendix D). To understand how well the RDSS performs, the most helpful feedback was received from the short answer questions. Both manifest and latent themes where identified from these responses to understand how well content was incorporated, how well it performs as a RDSS, and the overall usefulness of the RDSS as a sustainable recreation tool. This content is presented in the section that follows.

Content

Four themes emerged concerning content the respondents believe is necessary or beneficial to include in a RDSS to aid in recreation decision making: *transportation, accessibility, base map information, other public lands*. These themes were mentioned by at least two of the respondents. Respondents' comments concerning these themes are discussed next.

Transportation to get to trailheads was mentioned by two participants. As in the focus group section, *accessibility* of particular recreation sites was emphasized. The RDSS needs more than the basic highway base map. Some can be accessed by bicycle, some by using public transportation, and others by private vehicle. Letting the user know what is needed to get to a trailhead will facilitate access. Many of the forest service roads are maintained at different levels of improvement, from needing only a compact car to a four-wheel drive vehicle. Including a transportation layer which is filtered for different modes of transportation would help people access recreation sites more easily. For instance, one participant (FG03) commented "Adding a filter for transportation options to get to the trailhead (i.e. local bus route link and bike trails)" would be beneficial (see (viii) in Appendix C). This is something that has been indicated as important for a recreation map.

Another improvement suggested for the *base map* was to provide more detailed topographic information on the base layer and include trail mileage corresponding to hiking trails. These two improvements were mentioned by three respondents of the evaluation survey. One respondent mentioned topography and seasonal closures of trails as being important to include. "Definitely more detailed topographic map, maybe seasonal closures or a link to when seasonal closures occur." (FG01) Including a more detailed topographic map and adding trail mileage may help the user understand the terrain corresponding to given trails and help them evaluate their relative degrees of difficulty (see (ix) in Appendix C).

Overall, the RDSS focused on recreation areas and sites that correspond to *public lands* and did not include those that are privately owned and managed but open to the public. The evaluation also gave participants the opportunity to mention if there are any areas that were left out and are important to include. One of the participants mentioned an area, owned by The Nature Conservancy, which is open to the public. This would be important to include because the TNC has a large presence in Missoula County and its land is open to the public with some of the same regulations as the adjacent lands (see (x) in Appendix C).

Performance

Performance was another category the focus group participants were asked to provide feedback on. For this project, performance means how well the map performs as a recreation map and for helping users find places to recreate while also informing them acceptable recreation behaviors. There were two such questions in the evaluation survey, and one theme emerged from each. The two themes are *motorized recreation impact* and

volunteer opportunities. Overall, respondents felt positive about the map informing users of what recreation behaviors are acceptable.

One aspect that was discussed only briefly in the RDSS evaluation was *motorized use*. There was not a representative present from a motorized recreation group to discuss their view on what are most acceptable behaviors in motorized areas. Therefore, a lot of information on motorized use is not present in the map. One respondent noted that motorized use influences their recreation decisions by stating "I think it [the RDSS] provides all sorts of information for low-impact recreation. I assume sustainable recreation doesn't include motorized use but that is one form of recreation that I think is missing." Low impact would include hiking and biking, and other activities that aren't motorized forms of recreation.

Another respondent thought the map was "such a great sustainable recreation map (FG02)". It showed what the "sustainable trail use practices were for trails", but they thought it still could be improved. The suggestion that was given was to add a link to local trail projects for *volunteer opportunities*. This suggestion is in line with one aspect of how the focus group values the recreation areas in Missoula County. There is strong community involvement with improving recreation areas, either through conservation measures, volunteering time to help with the annual Clark Fork River clean up organized by the Clark Fork Coalition, or to lend a hand and maintain mountain bike trails with Mountain Bike Missoula. If people are informed of these are opportunities and events, they might be willing to engage with them or simply better appreciate all the work that makes the recreation areas so nice – this will also promote sustainable recreation.

Usefulness

Overall, the focus group members found that the RDSS would be useful in helping to find a place to recreate, gather information about an area, and inform them about what activities are most acceptable in different areas. Responses were mixed though. One respondent noted its utility in identifying areas to recreate in, which in turn benefits the existing recreation-oriented community culture. Another respondent saw it as one tool in a tool box to promote sustainable activities. The last respondent would like to see more about environmental impacts of recreation (see (xi) in Appendix C).

Discussion

This research was structured to develop and test a methodology for the improvement of sustainable recreation and answer how well interest group knowledge is able to be incorporated into a RDSS for sustainable recreation activities. It employed a focus group process using the user-centered design method proposed by Tsou and Curran (2008). The research questions evaluated how well local representatives' knowledge concerning appropriate recreation behaviors can be incorporated into a web GIS, what layers, activities, and information do participants want to include in a RDSS, and the utility of Esri's ArcGIS Online platform to construct such a RDSS. This research also produced some important findings for sustainable recreation, PGIS, and the use of RDSS in general.

Overall, the PGIS process was found to be highly successful method for creating a sustainable recreation map for a community by using participants from a diverse set of interest groups. Just as Grasseni (2004) found, phenomenology and shaping one's vision

of the landscape and one's identity was key to the diversity of knowledge that was incorporated into the RDSS. Furthermore, the incorporation of participant knowledge into the RDSS proved to be a useful way to express what activities are acceptable in an area. Furthermore, with help from the participants, this research answered what content local recreation groups, advocacy, and conservations groups would want to include in an interactive map to make recreation activities more sustainable for a community, and how well an interactive map is able to function as a sustainable recreation tool.

This section provides a discussion of the role PGIS had in creating the RDSS and the factors that influenced the content that was specified by focus group participants to promote sustainable recreation activities. Also discussed are the roles that an RDSS can serve as a sustainable recreation tool, how well the collaborative process performed in creating such a RDSS, and the utility of ESRI's AGOL for the creation of such a tool. The findings emerging here are then compared those from to other studies, and questions arising from previous research will be addressed.

The PGIS Method

This research used PGIS methods to create a sustainable recreation map of Missoula County. As we know a PGIS is generally used as a development tool to promote community identity, empowerment, and the creation of social capital (Brown and Kytta 2014). In this project the focus group session is the method that is used to gather public knowledge and is essentially PGIS. These benefits seem to have been promoted in this study, but the PGIS element also offered some challenges. These included: participants felt that the focus group would not address concerns they may have, the scope of the map was overwhelming for the amount of time that was set aside for the focus group session,

and in a couple of occasions participants did not want to offer their personal areas of interest. These challenges have been experienced by others as well (Carver et al. 2001, Goodspeed et al. 2016). Every participant walked away from the session learning something new about the area they live in. PGIS is a powerful method to promote broader awareness of issues that others, including vested interests, find important.

Having a diverse set of interests represented in the focus group, a central challenge to this project was that all participants would feel they were able to speak their minds but not create an environment for debate. It was emphasized at the beginning the session that charge to the focus group was to brainstorm ideas and not debate management practices – this helped to create an open and accommodating environment and promote the sharing of knowledge and opinions. In this project, all participants were interested in recreation and were all eager and willing to work together toward a common goal of promoting respectful recreation behaviors.

The map was an important tool to help participants brainstorm and respond to the research questions. Recreation maps are often used to view particular areas, but those areas are generally not viewed relative to other areas. Participants mentioned how nice it was to look at the entirety of Missoula County on one map, with all the potential recreation areas shown on it. One participant was surprised that there was CSKT land in Missoula County. This is another example of how the PGIS is a learning experience for the participants as well as the researcher. The PGIS approach allows everyone to contribute knowledge to creating an interactive map and taking away knowledge as well.

What makes this a sustainable recreation map is how it might influence the actions of the people who use it. Participants mainly thought that this could be achieved in

two ways, first by teaching users about the history of the areas and why they are valued, and secondly to help make users more aware of the infrastructure that has been provided for the public to use. Incorporating information about why the community values certain areas was quite straightforward, as was informing users of the available infrastructure and what activities are allowed and are most acceptable in given areas. What was a little more difficult was identifying and specifying areas that focus group participants enjoy visiting.

Additionally, participants' thoughts concerning acceptable activities (in given areas) tended to vary. One participant who belonged to a Nordic ski club valued the tranquility of an area and wished that snowmobiles were banned so that they could enjoy the "pristine wilderness," while another participant felt that snowmobiling is too fun to ever be banned. This conversation really shows how difficult it can be to create a sustainable recreation map because everyone has a differing opinion of what activities are most acceptable in an area. Therefore, the map works as more of a tool to find out what activities can be expected when visiting an area, and what sort of behaviors are *most* acceptable.

The more information that a person can acquire in relation to their own interests as well as others, the better that sustainable recreation will be promoted and realized. The PGIS method lends itself well to help accomplish this goal - it can lead to more respectful decisions made by those who recreate. After, observing the focus group, a different definition of PGIS came to mind: PGIS is a process of a group writing a story about the area and places depicted on a map, virtual or real. Participants locate areas of interest to themselves, sometimes telling stories and giving information about the area that may have never been known by the researcher and sometimes other participants.

Sustainable Recreation

The methodology used in this research was successful in creating a RDSS that participants felt would promote sustainable activities. Participants felt that their ideas and knowledge of the area were able to be incorporated into the tool. Additionally, participants believed that informing users of the history and natural history of an area is just as important than letting them know about most acceptable activities. As Arni (2013) mentions with respect to planning and management practices, when creating a recreation map of an area the cartographer should consider potential impacts it could have to an area. Just how to create a recreation map that does not adversely affect the environment or community of the area depicted is still an unexplored subject. This research demonstrates that not only do participants want to show where areas are, but they also want to inform visitors of what activities may adversely affect an area and foster in them an appreciation of an area.

This research has given an insight into how the PGIS process can aid sustainable recreation management. Prior work has shown the same connection between PGIS, involving local recreation groups, positive effects on communities (Grasseni 2004; Arni 2013). What this research has discovered is that creating a forum for representatives of local groups to discuss sustainable recreation activities produces knowledge that can be provided to the public to help individuals make respectful decisions. Of the several groups that were represented in the focus group discussion, a great amount of work has been done in the area. The participation from these individuals provided local knowledge concerning what should be included in a RDSS for sustainable recreation.

With the many views a community might have, there is always the chance of encountering an idea or recommendation for a RDSS that may not be a practice or behavior that is sustainable as defined here. To help ensure that interest groups' recommendations do promote sustainable activities, throughout the PGIS process the importance of adhering to a given working definition of sustainable recreation should be emphasized and discussed. After all, the PGIS method is a learning experience for everyone involved. Still disagreement on issues that depart from the concept of sustainable activities will arise. In this situation Sanchez (2017), recommends following scientific rigger and explaining and demonstrating the facts to the group of interest in order to foster trust in the investigator.

PGIS and Collaborative Planning

Grounded in collaborative planning theory, this research uncovered the values, beliefs, and the experiences of interest groups as relate to sustainable recreation for inclusion in a RDSS for such. Gray (1989, 57) described the process of collaborative planning as being comprised of three phases: 1) a problem setting phase in which interest groups become involved and a consensus is established, 2) a direction setting phase in which the groups interact in an effort to reach consensus, and 3) an implementation phase in which they work to implement outcomes through individual and joint actions. Just as Simao et al (2009) points out, spatial planning is a complex enterprise in which the planner (or decision maker) often is not fully aware of the range of factors involved or the implications of each. Just like planning, in designing a sustainable recreation RDSS for an area this research showed that these steps were essential for the gathering of local knowledge and its implementation.

The problem setting phase of this research involved speaking with interest groups in the area explaining the purpose of this project to create a RDSS focusing on sustainable recreation. In asking questions and volunteering to participate, the representatives showed that sustainable recreation matters to them. And once convened in the focus group, consensus was quickly reached amongst participants to further sustainable recreation for the community of Missoula. One participant stated "this is such a great and interesting project (FG02)" with other participants voicing similar sentiments.

The second step, or the direction setting phase, really began at the beginning of the focus group discussion itself. During the introduction of the focus group discussion it was emphasized that the goal was not necessarily to reach consensus and that everyone's opinions should be respected. Fostering a respectful environment allowed participants to really share their opinions without debate that could have detracted from obtaining information pertaining to the content of, and views about, a sustainable recreation RDSS. Participants really felt that a focus group session including interest groups of a community is an effective method to create a RDSS. Additionally, this step allowed focus group participants to learn the views of other groups and consider their own in a new way.

The implementation phase occurred throughout the process of creating the RDSS, with joint and individual action. Joint action was demonstrated during the focus group session in which participants collaborated on ways to best promote sustainable activities. Additionally, as encountered in this study, contested spaces were briefly discussed amongst participants. A recommendation concerning how to handle such situations is presented in the conclusion section. These three collaborative planning steps were crucial for the successful development of the RDSS.

Web GIS Design

The design of a web map for a RDSS proved to be an extensive process. The software used to develop the RDSS included ESRI's AGOL, ArcGIS Pro, Flickr, Mapbox and Adobe Illustrator CC. Flickr and Mapbox are both open source software packages while ESRI's AGOL and ArcGISPro, and Adobe Illustrator CC, requires subscriptions; this aspect could make the process of making a recreation map for tourism by an independent business difficult. However, certain elements of the RDSS design and development workflow could be accomplished using open source software packages. Flickr and Mapbox provide free access to anyone with an internet connection and the ability to upload photographs. QGIS is a no cost alternative to ArcGIS Pro that can be installed on a PC or mac computer. QGIS offers the necessary tools to create and manipulate data that can be later loaded into AGOL. An open source alternative to Adobe Illustrator CC is Inkscape and can be installed on a PC. Inkcscape would allow the user to edit icons and anything else that needs graphically modified before being used in AGOL. These no cost alternatives would allow data to be edited and graphics to be constructed for a RDSS. Additionally, both Adobe Illustrator CC and AGOL are subscription services and not a one-time cost to run.

These programs require knowledge and experience to use. This is seen to be a limitation for any community or business looking to develop a RDSS at a reasonable cost. Knowledge on how to manage and manipulate geospatial data is needed to operate ArcGIS Pro or any of the alternatives. This is essential in order to configure data for use in AGOL, and to create a functional and interactive RDSS. The use of Mapbox in con-

junction with AGOL proved to be necessary to create a customized base map which participants wanted to see in a recreation map. In addition to the financial aspect, these aspects relating to the diversity and technicality of the software and their use for the creation of a RDSS could prove to be a limitation for interested parties.

Arc GIS Online, on the other hand, proved to be a platform that was easy and intuitive to use given proper GIS training and experience. AGOL is an online, collaborative web-based GIS that allows an individual with limited training in the software to create and share maps, applications, and data with ease. I had a similar experience using the software. Previously, I had only a two-week intensive course on using the software and was still able to create a functional RDSS. It provides a more streamlined interface than ArcGIS PRO, Adobe Illustrator CC, or Mapbox, and this makes it more easily accessible and learnable. Additionally, someone could use online resources and discussion boards to help with technical questions. To do some of the more advanced cartographic designs, such as incorporating symbols in the pop-ups in personalized ways, the designer needs to know how to write computer code (HTML). This is more of an advantage to the design and not necessarily a hindrance to the overall functionality of a RDSS.

Not all of these extra software were needed to build the RDSS. Overall, the design of the RDSS received positive feedback for its design, as seen in the RDSS Evaluation section above. This shows that a well-designed web map was able to be created using AGOL for recreation purposes. AGOL allows the customization of icons, colors, tools, query, and searches to make a suitable recreation map.

With time, features on the ground will change, values of a community will change, and thus a RDSS will need to be maintained and updated. There are a few options that would help reduce the amount of maintenance to such a map. Content that relates to infrastructure, for example, could be added as layers that are hosted by the National Forest Service or another public entity thus permitting automatic, or nearly so, updating of content.

Another possibility would be to crowdsource the map content. Just as Carver et al. (2001) used PGIS to determine community members' feelings on a space of open ground that is to be developed using a hotspot mapping tool, ArcGIS allows for the collection of information from the public using Arc Collector. This application would allow the wider community to provide content, allowing anyone to share their area of significance and why they value it and what activities are acceptable in that area. However, there might be a need to moderate such contributions or task an entity with vetting such suggested changes. These options would make the RDSS much more dynamic helping to reduce the amount of work to maintain and update the map.

Conclusion

Project Structure

The project included all the steps necessary to create a sustainable RDSS. It engaged participants from a variety of interests in the community. Having participation from these different groups allowed for the creation of a more accurate and probably less biased sustainable RDSS. As Healey (1997) points out, communication plays an important role in spatial planning. Using the prepared base map, collaborating interest group members often identified and referred verbally to specific recreation areas and features.

An example was a participant describing trails that get heavier use, like going deep in the Bob Marshall Wilderness Area, or following the sway crest up into the Mission Mountains there's a lot to be had up in Glacier Lake. The participants were able to discuss appropriate behaviors pertaining to certain areas with the result of usually arriving at a consensus concerning how they should be represented in the RDSS. Thus, collaboration in this study and in this sense benefited from two things, a map for participants to view and refer to, and a means of communication via the focus group.

An example of an alternate method for collecting such information, which is less of a collaboration method and more one of spatial correspondence mapping, comes from the MapMe™ mapping software. This is an interactive tool, which can be used to collect useful information for planning purposes, that can be used from any computer with an internet connection. While this method does not allow for social interaction between participants, it can produce useful information from a wider audience for planning purposes.

The evaluation phase was essential in that it proved to be helpful in receiving additional feedback from the focus group members. It allowed them to reflect on what was discussed in the focus group itself and provide additional details that might have come to mind between the time the group met and when they evaluated the RDSS prototype. The focus group session served as a learning experience for everyone involved and the information continued to flow.

There are a few limitations of this study that should be addressed. In hindsight, it would have been useful to have one more focus group session with the same participants after the evaluation survey. This would have allowed for more ideas to arise for further refinement of the sustainable RDSS. Additionally, the focus group was diverse, including

individuals from a range of wilderness and natural resource advocacy groups, student recreation groups, and land conservationists. However, to more fully capture the full spectrum of interests in the area, it would have benefitted from the inclusion of one or more members from a local Native American Tribe and/or other minority groups, hunters and angler organizations, and any other natural resource-based groups belonging to the community such as Trout Unlimited and Backcountry Hunters and Anglers or organizations promoting motorized recreation.

Additionally, in this study the issue of contested spaces arose. Snowmobile (i.e., motorized recreation) use of certain areas arose in discussion, and those involved recognized that the purpose of the focus group was not to debate whether certain activities should be allowed, or not, and quickly moved on. But, it did provide an opportunity for participants to explain how they avoid these contested spaces. This project was designed to emphasize that the focus group session was not a place to debate policies and regulations or reach consensus, but a place to explore ideas. It was emphasized that respecting the views of other participants should be practiced.

Future Research

The research presented here tested a methodology for the incorporation of local knowledge into an online RDSS for sustainable recreation. It has shown that it is important and beneficial to consider local knowledge when creating such a tool to ensure that the interests of a community are considered and conserved. Continued research on the implementation of such a RDSS would allow for the investigation of how well it can serve to promote sustainable recreation and how well it protects community interests. A

comparative approach employing surveys and/or semi-structured interviews of recreationalists who used and those who did not use the RDSS might prove useful for such.

This study on sustainable recreation offers insights into how public interest groups view current management practices versus desired management practices. Continued research focusing on the capture and documentation of public views on current versus desired management views may be a big swing away from RDSS, but not necessarily from sustainable recreation. The PGIS methodology tested in this research captured how particular recreation activities are viewed in certain areas, and this information might prove useful in the management arena. With the increased use of the internet to gather information for individual recreation decision making, recreation decision support systems have great potential to incorporate and help disseminate lots of information in an efficient manner. With collaborative processes such as used here, information can be gathered in such a way so that more sustainable forms of recreation can be promoted and hopefully realized.

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APPENDIX

APPENDIX: A

Focus Group Guide #1

Introduction:

1. Welcome
   Thank you for agreeing to participate.

   Introduce yourself and the note taker
   Review the following:
   - Who we are and what we're trying to do
     The objective of this study is focusing on sustainable recreation by developing a RDSS. The aim of this tool is to bring awareness to visitors of Missoula County to what kind of things the local community values about the public lands in the area and how they can recreate in a more sustainable way.

     Sustainable recreation is operating in harmony with the local environment, community, and cultures, so that these become the permanent beneficiaries not the victims of recreation development.

     Additionally, the project you are involved is looking into how well the collaborative planning process can be used to create an interactive map for sustainable recreation. We are paying attention to knowledge and concerns that arise from you as representatives when discussing amongst yourselves (hiking, mountain biking, climbing, fishing).

   - Why we asked you to participate
     We want to incorporate local knowledge into a tool such as an online interactive map for sustainable recreation. Here in Missoula, the public lands provide many types of ecosystem services such as drinking water for Missoula and also recreation benefits.
       - *This is why we have tried to create a diverse group including individuals from conservation groups and recreation*

     We are very interested to hear your opinions on what you would like to include in an interactive map that serves as a (RDSS). The way this focus group will work is I will ask you to:
       - *Locate areas that your group finds to be significant,*
       - *why you find those areas to be significant,*
       - *the most appropriate recreation behaviors within them and*
       - *how you would like to include this information (Pop-ups, links, layers)*

   - Briefly go over the interactive map
       - *where the information will go*
       - *querying*

2. Consent Process

   - What will be done with this information
     We would like to record the focus group event so that we can make sure to capture the thoughts, opinions, and ideas we hear from the group. Before we get started I want to remind you that your responses will never be connected with your names and identifying information will be removed for presentations and publications. We have some informed consent forms for you to sign so you know how the focus group information will be used and your rights as a member of the focus group. After you fill these out we will start the focus group. Thank you again for being here. Does anyone have any questions before we start?"

3. Explanation of the process.

   About focus groups
   - In this project, we are starting with a focus group discussion and then, I will follow up with an evaluation of the product you help create with a questionnaire/evaluation. The reason for using this method is that we can acquire more in-depth information about what you envision for a RDSS that helps to communicate the knowledge you provided about particular areas in Missoula County.
   - We want to learn how you envision a sustainable recreation map and what content you would like to provide
   - Chance to explore ideas of what you want to see in this map
   - Not trying to achieve consensus, we're gathering information
   - Please respect the views which each participant brings to this focus group

   Logistics
   - Focus group will last about two hours.
   - Two options – hardcopy map / interactive map **(map-me.org/sites/SustRecFG)**

4. Turn on Video Recorder

5. Introductions
   - Go around table: introduce yourself and the group you represent. Name, what group you're a part of, and what are you most looking forward to this spring.

Discussion begins, make sure to give people time to think before answering the questions and don't move too quickly. Use the probes to make sure that all issues are addressed, but move on when you feel you are starting to hear repetitive information.

Opening Questions:
1.)

Questions:

1. As a representative of a larger group locate what areas are significant or important to your group?

    a. What activities are your group interested in?
    b. What "features" are you interested in protecting/preserving in order to protect the quality of this activity (streams, trails, cultural areas etc.)?

2. Generally, describe what your group values about this area.

    a. What traits do these areas have that make them important or significant? (native bull trout, great skiing conditions, nature at its purist form)
    b. What makes these places a "special place"?
    c. What significance do these areas have to the larger community?

3. What recreation behaviors are most acceptable within these areas?

    a. What are some activities that may diminish the specialness this area has to you and your group?
    b. What activities enhance your special place?
    c. Are there ways to enjoy these areas harmoniously with others?

4. What information would you like to provide to others about these areas to help sustain the health of the environment, community or cultures?

    a. Thinking back, what are some experiences where you thought "if only they knew" about a certain recreation related issue?
    b. What information do you think others may enjoy learning more about?
    c. When looking at a forest service map or another map made for recreation, what information have you thought would be handy to include or know about?
    d. How do activities affect these areas at different times of the year? (Biking on muddy trails, elk wintering areas, backcountry camping)

5. How should these ideas be incorporated into an interactive map?

    a. In an interactive map what is the most convenient way to inform others on these topics? How would you like to be informed?
    b. How do you envision your areas of interest being displayed on the map?
    c. What is the best way to inform the user? (in the pop-up, link to website, in the legend)(ease of use)

That concludes our focus group. Thank you so much for coming and sharing your thoughts and opinions with us. We have a short evaluation form that we would like you

to fill out if you time. If you have additional information that you did not get to say in the focus group, please feel free to write it on this evaluation form.

Materials and supplies for focus groups

- Sign-in sheet
- Consent forms (one copy for participants - 15)
- Name tags
- Color marker for each participant
- 50 questions sheets
- Two - three large map of study area
- Plastic sheets to annotate on over the study area
- Focus group discussion guide for facilitator
- Video camera, audio recorder
- Notebook for note-taking
- Pizza and La Croix

Activities Allowed in Areas:

- Hike
- Float
- Fishing
- Hunting/Trapping
- Gathering Food, Plants
- Camping
- Mountain Biking
- Motorized Use
- Mountain Climbing

That concludes our focus group. Thank you so much for coming and sharing your thoughts and opinions with us. We have a short evaluation form that we would like you to fill out if you time. If you have additional information that you did not get to say in the focus group, please feel free to write it on this evaluation form.

APPENDIX: B

Focus Group RDSS Evaluation Survey

Evaluation (Strongly Agree (1) – Strongly Disagree (7))

1. Prototype Interface Questions
   Map Icons are easy to understand.
   The map is easy to navigate.
   The colors are appropriate

2. Map Display
   The map display gets users interested in recreation.
   The map display is helpful to gather information about an area.

3. Tools.
   Hyperlinks to other websites are relevant and useful.
   The map helps you in making a decision on where to recreate.
   The map functions are comprehensible (e.g. tools, queries, searches)

4. Data Layers
   You were provided enough information to make a decision on where to recreate.
   You feel well informed about what recreation activities are most acceptable in an area.
   After finding a place to recreate you were informed about how an area is important to the community.

5. Usefulness
   This map will help sustain the health of the environment, communities and cultures in Missoula County.
   The Focus Group process was an effective method to create a map of this type.

Short Answer Questions

1. (Information Content)
   Is the necessary information provided in the map to help determine how recreation activities may affect an interest group?
   Is there any missing information you would include?

2. (Performance)
   Does this RDSS help find a recreation area and inform the user in an effective manner, while also being useful for locating interested recreation areas?
   Are you overwhelmed by any aspect of the Interactive map display?

3. (Usefulness)

How useful is this in informing users of the significant an area has to an interest group?
Are there any suggestions you have to improve this sustainable recreation map?

6. (Closing Question)
   How well does this recreation map work to help sustain the health of the environment, community and cultures of Missoula? What is your overall impression?

APPENDIX: C

(i) I circled essentially downtown or like lower Rattlesnake uh and then right now on my mind is Mount Jumbo and uh this time of year over the next two months is really fun because the snow melts more and more and more all the way up to Sheep Mountain and like every week I go up there and see how far I can get between now and mid-May, and so I just picked that [area] because it's a place that's on my mind right now and its really uh when I think of spring I think of this area a lot because it's a fun place to get to right from downtown more or less feels like wilderness when I get out there (Focus Group Participant FG01).

I think I'm going to focus mostly on places that are accessible to people living on campus, I think that's one of the biggest things. Especially for new students who come here. Because a lot of them don't have cars and they want to go places. The M is the biggest thing I think. So generally what we would value is accessibility for students. Yeah there is so much I could circle (Focus Group Participant FG03).

(ii) Well, I'll talk about one of my favorite parts of town which is the river corridor which I am sure (FG02) uh cares a lot about that too, um and uh I love the fact that uh the Clark Fork is managed as a non-motorized river through town which you know there's no guarantee it would be managed that way Fish Wildlife and Parks just only in the last five years um finalized some rules about that (Focus Group Participant FG07).

I will draw the Clark Fork River corridor and include the old dam site as well, but umm so really just yeah, just the urban area (Focus Group Participant FG02).

(iii) I think what I'll highlight I mean I love everything that everyone has put on the map, but what I spend the most of my time thinking about are the roadless wild areas that we have left, that don't have any permanent guarantees that they'll stay that way and we are lucky to have quite a few of those areas in Missoula County. So I'll just generally draw what the roadless boundaries are. And maybe that's worth showing on the map, umm the places that function a lot like the places we've designated as wilderness, but most people and most people wouldn't consider it being separate from wilderness, but actually are (Focus Group Participant FG07).

(iv) Well, Pattee Canyon has something for everyone if you are insane and really like hills you've got the south side and if you want the flat good groomed trails you have the north side. It's great when you have late classes you can still go out there and get some decent skiing in (Focus Group Participant FG06).

(v) Don't create bandit trails, don't um bandit trails are just like random trails down to the river that really promotes erosion along the banks and that's unhealthy um like to really clean up your trash don't bring glass um but really like be careful of the riparian vegetation that's really important and it's something that gets ignored a lot in the summer time (Focus Group Participant FG02).

(vi) I mean I'm curious about this, what information would you provide to people in order to help sustain the health of the environment, community, and cultures. I mean it's like we're thinking about it, but we're not saying it. Like infrastructure. Like what trails are there, or I mean the more you know about what is available you won't go using your own thing, if you know there's a campground down the road, if you knew there was a toilet, you know there's this trial system, so I think that's more actually important to let, and I guess that's the point of the map. Letting people know if there is a good area and letting them know what infrastructure exists for their recreation. So they're not creating a social trail or a bandit trail down to the river or all of these other things...pooping in the woods when there's a toilet right there or all these things so (Focus Group Participant FG01).

(vii) I mean there's so much information that can be shared about an area and it would be a lot of work…I would love to see a regulations layer, the history, layer, the natural history layer, the cultural history layer, I mean it's too much, but it's interesting to think about how that can be integrated into a map in a sharp way, the technology is there (Focus Group Participant FG01).

(viii) I think incorporating a road access layer would be important to this process as well given that in some cases the road network (especially on forest service lands) can be circuitous. A roads layer would help day trippers and backpacker alike (Focus Group Participant FG07).

(ix) I think trail mileages are important for the process of answering the essential question "where to recreate" especially for a broader public and for those that have time constraints on their free time.

Also, a more detailed topographic map, would help visitors understand the terrain (Focus Group Participant FG07).

(x) One I can think of is TNCs massive acquisition on the east side of the Lolo (gold creek area). It is a huge area and is open primarily for recreation. The Gold creek trailhead is provided but the ownership isn't and I think that might be important because its recreation regulations are fairly similar to public lands and is in a way pseudo public lands. Tons of hiking and biking and camping opportunities back there. Then again, I don't know whether TNC is okay with its lands being included on a recreation map like this (Focus Group Participant FG07).

(xi) I'm not sure that that is the primary value of the map on its face, yet that may be one result. Community and culture is a hard one to define and it would be hard to find the nexus between this map and influence on the culture of the county. Its primary value is its utility for recreation planning, which is a cornerstone of the area already. (Focus Group Participant FG07)

I would say it's a tool. Part of a tool box. It's definitely helpful in informing people about history of an area. More info can always be better on cultural and natural history. The history of the land, etc... (Focus Group Participant FG01)

I really love the idea of the map and what is has become so far. I would definitely add more about the environment. (Focus Group Participant FG02)

APPENDIX: D

Table 3: RDSS Evaluation

Q1 - Map Icons are easy to understand.

#	Answer	%	Count
1	Strongly agree	75%	3
2	Agree	25%	1
3	Somewhat agree	0%	0
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q2 - The map is easy to navigate.

#	Answer	%	Count
1	Strongly agree	50%	2
2	Agree	50%	2
3	Somewhat agree	0%	0
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q3 - The colors are appropriate.

#	Answer	%	Count
1	Strongly agree	50%	2
2	Agree	50%	2
3	Somewhat agree	0%	0
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q8 - The map functions area comprehensible (e.g. tools, query, searches).

#	Answer	%	Count
1	Strongly agree	25%	1
2	Agree	75%	3
3	Somewhat agree	0%	0
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q9 - You were provided with enough information to make a decision on where to recreate.

#	Answer	%	Count
1	Strongly agree	25%	1
2	Agree	0%	0
3	Somewhat agree	75%	3
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q10 - You feel well informed about what recreation activities area most acceptable in areas.

#	Answer	%	Count
1	Strongly agree	50%	2
2	Agree	0%	0
3	Somewhat agree	50%	2
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q4 - The map display is helpful to gather information about an area.

#	Answer	%	Count
1	Strongly agree	50%	2
2	Agree	50%	2
3	Somewhat agree	0%	0
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q5 - The map display provokes your interest in recreation.

#	Answer	%	Count
1	Strongly agree	50%	2
2	Agree	50%	2
3	Somewhat agree	0%	0
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q6 - Hyperlinks to other websites are relevant and useful.

#	Answer	%	Count
1	Strongly agree	50%	2
2	Agree	50%	2
3	Somewhat agree	0%	0
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q11 - After finding a place to recreate you were informed about how an area is important to the community.

#	Answer	%	Count
1	Strongly agree	50%	2
2	Agree	0%	0
3	Somewhat agree	25%	1
4	Neither agree nor disagree	25%	1
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q12 - This recreation map will help sustain the health of the environment, community and cultures in Missoula County.

#	Answer	%	Count
4	Strongly agree	50%	2
5	Agree	0%	0
6	Somewhat agree	50%	2
7	Neither agree nor disagree	0%	0
8	Somewhat disagree	0%	0
9	Disagree	0%	0
10	Strongly disagree	0%	0

Q13 - The focus group process was an effective method to create a sustainable recreation map.

#	Answer	%	Count
1	Strongly agree	75%	3
2	Agree	0%	0
3	Somewhat agree	25%	1
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0

Q7 - The map helps you in making a decision on where to recreate.

#	Answer	%	Count
1	Strongly agree	75%	3
2	Agree	0%	0
3	Somewhat agree	25%	1
4	Neither agree nor disagree	0%	0
5	Somewhat disagree	0%	0
6	Disagree	0%	0
7	Strongly disagree	0%	0