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A Guide to Human Ecology Mapping:

An Approach for Understanding Human-Environment Connections

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Cover Page Image

Community members mapping during a workshop for the Mount Baker-Snoqualmie National Forest Sustainable Roads Strategy project. Image credit: Mt. Baker-Snoqualmie National Forest public affairs office.

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Acronyms and Abbreviations

HEM	Human Ecology Mapping
GIS	Geographic Information Systems
MBSNF	Mount Baker-Snoqualmie National Forest
MHNF	Mount Hood National Forest
PPGIS	Public Participation Geographic Information Systems
RRCR	Routt Recreation and Conversation Roundtable
SRC	Sustainable Roads Cadre
USFS	United States Forest Service

Overview

Places matter to people, and maps can help people and communities share why places matter. Over the past 30 years, public participation GIS (PPGIS) and other forms of human ecology mapping (HEM) have become important ways for agencies, non-governmental organizations, environmental and community advocacy groups, university researchers, and others to learn about or advocate for what matters to people about landscapes they visit, use, or love.

HEM is a method for mapping human-environment interactions and connections. This manual is intended for the planner or practitioner who is interested in using HEM to strengthen their engagement and inclusion of community members for environmental decision-making. We begin this manual with an introduction to what HEM is and why to use it. Because understanding the audience for HEM is important for collecting high-quality data, we go over how to work with data users to understand how much and what kind of data needs to be collected, and we offer advice for how to develop effective community engagement strategies. We discuss three methods for collecting HEM data: the workshop, the intercept approach, and the online interactive map application. Each method has its strength, serving different projects in different ways.

Drawing from over a decade's experience designing HEM applications, we share some of our hard-won lessons on designing tools for public engagement and designing the map application. We then briefly discuss how to analyze HEM data, before concluding with how to report results back to the community. Finally, we have included vignettes from previous projects to illustrate our points.

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1.0 Introducing Human Ecology Mapping

We would all be lost without maps. They tell us where we are and get us where we are going. They lead us to the closest gas station or diner when we are perilously low on fuel. However, traditional maps do not tell a complete story. They do not tell us how people use a place, why they love it, how it binds them to their ancestors, or why they lie awake worrying that their special place will be spoiled. A traditional map cannot warn us about looming conflicts between the different ways that people, wildlife, and plants use and depend on a place.

That is where Human Ecology Mapping (HEM) comes in. HEM brings a map to life with social, cultural, and environmental meaning. Through community workshops, one-on-one conversations, and online map applications and questionnaires, HEM creates spatial data from people's knowledge, values, and preferences regarding the places where they live, work, and play.[1]

HEM falls under the umbrella of public participation geographic information systems (PPGIS). While many land management professionals are familiar with PPGIS and with GIS mapping in general, we have found that many are unfamiliar with using these tools to collect or analyze qualitative socio-spatial data about a place. This guide is intended for planners, community organizers, and scholars who are working on topics related to forests, rivers, parks, transportation networks, and more, who would like to know more about HEM.

In this guide, we describe HEM and its purpose. We introduce three common methods for collecting HEM data: workshops, intercept approaches, and online interactive map applications. We also explain how to build HEM applications[2] and describe common HEM analysis techniques.

This guide draws from over a decade of the authors' professional experiences. That work with HEM has primarily focused on forest environments, including Washington's Olympic Peninsula and Mount Baker-Snoqualmie National Forest, Oregon's Deschutes, Ochoco, and Mount Hood National Forests, and Colorado's Routt National Forest. However, HEM is also useful for mapping human activities and values associated with city and suburban neighborhoods, marine environments, rivers and lakes, and many other types of landscapes.

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1 McLain, R., M. Poe, K. Biedenweg, L. Cerveny, and D. Besser. 2013a. Making sense of human ecology mapping: An overview of approaches to integrating socio-spatial data into environmental planning. Human Ecology. 41: 651-665. doi.org/10.1007/s10745-013-9573-0

Brown G. and M. Kyttä. 2018. Key issues and priorities in participatory mapping: Towards integration or increased specialization?. Applied Geography 95: 1-8. doi.org/10.1016/j.apgeog.2018.04.002

2 A HEM application is made up of two parts: a map (paper or online) and a questionnaire.

1.1 What is HEM?

Human ecology is a science that takes a systems approach to understand how humans connect with their environment. These connections are sometimes visible in activities, such as hunting, hiking, mushroom harvesting, taking photographs, snowmobiling, and many others. They also include invisible connections, such as the meanings that people associate with a particular mountain, meadow, seascape, or other location. By capturing these complex connections in the form of maps, HEM makes it easier to combine them with other mapped data, such as vegetation types, wildlife distributions, or transportation networks.

By showing the diverse ways that humans connect with their environment, HEM helps identify areas of the landscape that are especially important for people and what activities take place in particular locations. HEM provides information about the variety of meanings that people attach to different places. Knowing what places are important for which people and why can help land managers understand how proposed management activities, such as building a campground, decommissioning a road, or putting in a cell phone tower, are likely to affect different types of users. This knowledge allows managers to propose actions that are less likely to result in conflicts and that allow for more effective use of financial and human resources.

Globally, HEM has been used to document land and resource tenure and uses, local knowledge about ecological conditions, the meanings and values that people assign to different parts of landscapes, locations where people feel safe and those where they feel threatened, as well as many other types of connections that humans have with landscapes.[3] The types of maps used to collect HEM data include sketch maps, pre-designed paper maps, aerial photos and satellite images, and digital maps, both on and offline. The methods used to collect HEM data vary, with the most common being workshops, intercept approaches, and online interactive map applications. Less common methods are mail questionnaires and individual mapping sessions paired with in-depth interviews. Which mapping technologies and methods will be most effective depends on a number of factors, such as who will be providing data, the HEM team's technological knowledge and skills, the financial resources and time available, who will use the data, and the role that data contributors or users will play in designing and implementing the HEM project.

3 McLain, R., M. Poe, K. Biedenweg, L. Cerveny, and D. Besser. 2013a. Making sense of human ecology mapping: An overview of approaches to integrating socio-spatial data into environmental planning. Human Ecology. 41: 651-665. doi.org/10.1007/s10745-013-9573-0

1.2 Why use HEM?

HEM can be a powerful tool for informing land and natural resource management decisions in many environments and at multiple geographic scales. For example, HEM can reveal the following:

- Where specific types of forest, rangeland, or marine uses are most concentrated.
- Where park, forest, or river users perceive their experience of the place to be threatened.
- Where roads are located that support the most diverse uses in a national park or forest.
- Which areas in a city neighborhood are perceived as unsafe.
- Which uses in a marine protection zone or along a river are most likely to conflict with other uses.

HEM benefits land and natural resource management agencies and non-governmental organizations by doing the following:

- Strengthening outreach to community members and organizations.
- Guiding difficult conversations with local communities and other members of the public.
- Capturing data that may not be readily available from other sources.
- Identifying places in the landscape that are important to people, or where people have concerns, challenges, or conflicts.
- Visualizing data to help land managers, urban planners, and others understand the spatial distribution of land uses, cultural values, and ecosystem benefits.
- Supporting work for a variety of land management decisions and projects, including transportation planning, park management, conservation planning, and neighborhood revitalization.

Some of the ways in which HEM benefits communities include the following:

- Facilitating the collection of social, economic, and ecological data that reflects community members' knowledge, values, and perspectives.
- Providing community members with the data and information they need to communicate effectively with policymakers and public planners.
- Expanding community members' involvement in public decision-making, increasing the potential for better public decisions.

For agency-driven projects, HEM's success depends on the agency's capacity to design and implement mapping, the agency's willingness to engage with the public, and whether community members see the value of participating. For community-driven projects, HEM's success depends on the community members' capacity to design and implement mapping. Whether agency- or community- driven, HEM projects require adequate time to create paper maps or an online interactive map application, collect and process participants' responses, and analyze and interpret the results.

2.0 Identifying the Audience for HEM

There are two HEM audiences: those using the data and those providing the data.

2.1 Who will use the data?

Before starting a HEM project, the project team needs to consider who will use or is likely to use the collected data, as well as how the data will be used. In some cases, the HEM project team is the main data user, because they have a question that requires spatial data to answer. More often, however, the HEM project team collects data for a community group, agency, or organization with their own questions that require spatial data to answer. In both situations, HEM projects need to be designed so that the data collected are useful for the data users.

In practice, if the data are meant to be used by individuals or groups other than the project team, collecting useful data requires:

- Having a clear idea of who the data users are likely to be.
- Working closely with them to identify the geographic area of interest.
- Understanding the questions they wish to have answered.
- Identifying whose data they would like to incorporate.
- Determining the types of analyses that would meet their needs.
- Knowing the audience that the data users would ultimately like to reach with their results.

2.2 Who will provide the data, and how can they be reached?

The key to a successful HEM project is to develop a community engagement strategy early. This strategy may be developed by the project team or with a partner organization. However, the project team needs to keep in mind that any strategy may need to be modified as they learn more about which engagement approaches work best. In many situations, it is helpful to use multiple methods for recruiting HEM participants.

Important steps to develop an effective community engagement strategy include:

- Identify who has an interest in the use and the future of the geographic area and topic being studied.
- Determine whether you want to hear from the informed public (persons most familiar with the issues being studied in the target area) or the general public.
  - **To attract the informed public,** engagement activities carried out by collaborative or interagency groups (e.g., watershed councils, forest collaboratives) and/or interest-related organizations and clubs, such as advertising the project in agency or organizational newsletters, websites, or email listservs are most effective.
  - **To attract the general public,** reach out through outlets such as social media, newspapers, or radio; advertise at community events (e.g., street fairs or farmers markets) and public venues (e.g., grocery stores, libraries, or community centers); and partner with local groups with broad influence.
  - **For some communities,** word of mouth may be the most effective approach for recruiting participants.
- Reach out to stakeholders or interest groups you already know. They may be able to suggest other interested parties to contact, and they may be willing to help advertise the project or pilot workshops, online map applications, or intercept approaches.
- Assess whether the list of stakeholders and interest groups includes as many potentially affected or interested communities as possible. For example, will the engagement strategy encourage individuals from a range of age groups to participate in the HEM activity? If the project seeks input about activities taking place in a recreation area, is the engagement strategy effectively recruiting both motorized and non-motorized user groups? Within a national forest, is the strategy reaching forest product harvesters as well as recreational users?
- Monitor the effectiveness of outreach activities throughout the HEM project. Outreach is an ongoing process. Collecting and continually monitoring demographic data as you go will reveal whether key audiences are participating, and will allow you to adjust your outreach to address gaps.

Vignette 1, about the Mount Baker-Snoqualmie National Forest Sustainable Roads Strategy, discusses the development of a community engagement strategy with a coalition of interest groups. Vignette 2, about the Mount Hood National Forest Latino Mapping Project, describes working with a nonprofit community organization to connect with a specific sub-group of the Latino community.

Vignette 1: The Mount Baker-Snoqualmie National Forest Sustainable Roads Strategy[4]

Figure 1: Participants mapping roads they value on the Mount Baker-Snoqualmie National Forest. Image credit: Diane Besser.

In the face of declining budgets in 2012, the Mount Baker-Snoqualmie National Forest (MBSNF) began travel management planning to determine which roads were likely to be needed in the future. MBSNF officials decided to use HEM as a public engagement strategy to find out which roads the public used and why they used them. The HEM data were analyzed alongside other spatially explicit data, such as hydrological, soils, and biological data, to prioritize which roads to maintain and their levels of maintenance.

The USFS Pacific Northwest Research Station and Portland State University ('HEM team') implemented the MBSNF HEM project in partnership with a coalition of organizations known as the Sustainable Roads Cadre (SRC). Led by the Wilderness Society and the Washington Trails Association, the SRC included 45 organizations representing a variety of interests, including off-road vehicle users, timber companies, tourism providers, and pro-forest access voices.

During summer and fall 2013, the HEM team collected responses from local stakeholders through workshops held in eight communities near the national forest. To reach broader local and non-local stakeholders, the SRC, in particular the

4 Cerveny, L., R. McLain, D. Banis, and A. Todd. 2022a. The use of socio-spatial data for sustainable roads planning: a national forest case study. Journal of Environmental Planning and Management. 97(8): 1-24. https://doi.org/10.1080/09640568.2021.1968807

McLain, R., D. Banis, A. Todd, and L. Cerveny. 2017a. Multiple methods of public engagement: Disaggregating socio-spatial data for environmental planning in western Washington. Journal for Environmental Management 204(1): 61-74. https://doi.org/10.1016/j.jenvman.2017.08.037

Washington Trails Association, hosted an online questionnaire that mirrored the questions asked during the workshops and shared the data with the HEM team. The following summer, the HEM team shared the online questionnaire results and the in-person workshops in listening sessions held in the eight communities.

The SRC's involvement was critical to the project's success. SRC members played a vital role during the design phase by identifying the appropriate scale for the map and what questions to include in the workshop mapping session, online questionnaire, and post-analysis listening sessions. Crucially, the SRC led community outreach for the project. By leveraging the coalition's diverse membership through the use of multiple participant recruitment methods – ranging from newsletter and social media announcements to flyers posted in public locations to word-of-mouth – the SRC reached a much broader and more diverse set of stakeholders than would otherwise have been possible.

Vignette 2: The Mount Hood National Forest Latino Mapping Project[5]

Figure 2: Participants mapping sites they value on Mount Hood National Forest. Image credit: Lee Cerveny.

National forests are mandated to develop forest plans that identify emerging management issues and ensure that forests meet the needs of diverse publics. The Latino population in the Northwest is rapidly growing, and uses forests more and more. Few Latino forest users participate in forest planning, and little is known about their priorities, values, and visions for public lands.

In 2018, social scientists from the USFS Pacific Northwest Research Station and Portland State University implemented a HEM project to find out where Latino forest users go in the Mount Hood National Forest (MHNF), what activities these forest users engage in, and why they value those places. The team first experimented with recruiting participants at a multicultural event that attracted many Latino people. However, the responses were disappointing because very few of the attendees had visited the MHNF.

To recruit Latino participants who had visited the MHNF, the team partnered with Vive Northwest, a nonprofit organization that connects Portland-area Latino residents to the outdoors. The partners co-designed and implemented three mapping workshops, two in the evening and one on a weekend afternoon. The weekend workshop was held at a county park and included a post-workshop hike.

5 Cerveny, L., R. McLain, D. Banis, and M. Helmer. 2022b. National forest visitation preferences and avenues to participation for urban Hispanic recreationists in the Portland metropolitan area (USA). Journal of Forestry. 121(1): 64-83. https://doi.org/10.1093/jofore/fvac023

Vive Northwest advertised the workshops and recruited participants through a video distributed on social media.

Meals were provided at all three mapping events, and the team ended each workshop with a raffle of donated outdoor gear and gift cards. Because participants' English fluency varied, a Spanish-speaking facilitator led the workshops, and several Spanish-speaking team members were present to answer questions. All workshop materials were made available in Spanish and English.

To reach a more diverse set of Latino forest users, the team also went out with a mapping board and questionnaires to a local lake popular with Latino people. The mapping participants at the lake were much more familiar with the MHNF than the workshop participants, and they mapped a very different set of places.

3.0 Collecting HEM Data: Three Approaches

HEM adds unique value by explicitly integrating and connecting place data with demographic and other data. This input can be collected in person through workshops, intercept approaches, or online. In this section, we briefly describe the key activities for each of these methods, as well as the benefits and challenges associated with each approach.

3.1 Workshops

HEM projects sometimes involve organizing a series of in-person mapping workshops to collect socio-spatial data about human-environmental connections. In a typical HEM workshop, the project team brings together a group of between 10-30 people for two to three hours to map locations that matter to them. Generally, the group is divided into smaller groups of four to five individuals, with each small group seated or standing around a table on which a large paper map of the area of interest has been attached (see Vignette 3). A facilitator leads the workshop, introducing the HEM project and explaining what the participants will be mapping, as well as how to mark the maps.

Participants can mark locations directly on the paper maps using sticker dots and/or markers. If using dots, clear tape should be placed over the dots to preserve correct placement. If multiple workshops are held during a project, the cost of printing paper maps can be reduced by covering the maps with a transparent plastic overlay.

Using a plastic overlay requires additional steps. Each overlay must have control points marked on it prior to beginning the mapping activity, so that the marks can be digitized with the correct geographic coordinates. Participants should use a permanent marker to mark their locations. After the marks have been digitized, these marks can be removed with a solvent, and the plastic overlay can be reused.

In addition to marking locations on the map, each participant fills out a questionnaire to provide additional details about the locations they have marked. For example, participants may be asked to describe the activities they do there, how often they visit, who they go there with, identify any threats they perceive to their enjoyment at that place, or what it is about that place that makes it important to them. After the mapping activities are completed, the facilitator leads a debriefing session to give the participants an opportunity to discuss what they observed or learned during the mapping session.

Benefits of using workshops:

- Workshop facilitators are available to help participants use the maps and answer questions that arise. This increases the likelihood of collecting higher quality data.
- Workshops often foster dialogue about participants' values and preferences related to the issue under discussion, for example around river health, use, and management.
- Mapping at a table with other individuals often generates connections, learning, and goodwill among participants as they share ideas and stories about places they visit. This convivial setting may also lead to higher quality data.

Challenges of using workshops:

- Workshops can be time-intensive for organizers and participants. Partnering with community groups can help spread the workload of organizing and hosting workshops.
- When people map in a group setting, they may be influenced by what others in the group are mapping.
- In contexts where the HEM topic is particularly controversial, some community members may refuse to participate in workshops out of fear that they will be treated disrespectfully by others or concerns over possible conflict. In such cases, it may be important to organize workshops for different segments of the community to keep the HEM mapping environment safe.
- Data collected on paper maps or transparent overlays need to be digitized for use in GIS. Time and labor to digitize the data will need to be factored into the project budget.

Vignette 3: The Olympic Peninsula HEM Workshops[6]

Figure 3: Participants mapping their important places on the Olympic Peninsula. Image credit: Lee Cerveny.

In 2010, the USFS Pacific Northwest Research Station partnered with the Institute for Culture and Ecology, an independent non-profit research organization based in Portland, Oregon, to develop an approach for collecting spatially explicit data about the cultural values associated with the Olympic Peninsula in western Washington. HEM was a method that the team felt would allow people to easily map those places most meaningful to them as well as the places where they participated in outdoor activities.

During 2010-2011, the team held mapping workshops in eight communities on the Olympic Peninsula, collecting a wealth of data from 169 residents. Workshop participants mapped 818 meaningful places and 1,594 outdoor activity sites. After digitization, the team entered the mapped data and the associated questionnaire responses into a GIS for analysis. The project demonstrated HEM's viability as an approach for generating sociocultural data for analysis alongside biophysical data.

6 McLain, R., L. Cerveny, D. Besser, D. Banis, A. Todd, S. Rohdy, and C. Kimball-Brown. 2013b. "Mapping Human-Environment Connections on the Olympic Peninsula: An Atlas of Landscape Values." Occasional Papers in Geography No. 7. Portland State University. http://archives.pdx.edu/ds/psu/15667

Besser, D., R. McLain, L. Cerveny, K. Biedenweg and D. Banis. 2014. Mapping landscape values: Issues, challenges and lessons learned from field work on the Olympic Peninsula, Washington. Environmental Practice. 16(2): 138-150. https://doi.org/10.1017/S1466046614000052

McLain, R., L. Cerveny, K. Biedenweg, and D. Banis. 2017b. Values mapping and counter-mapping in contested landscapes: An Olympic Peninsula (USA) case study. Human Ecology 45(5): 585-600. https://doi.org/10.1007/s10745-017-9930-5

3.2 Intercept Approach

Intercept approaches are on-site engagements that meet people where they are, whether that's at outdoor recreation and other field sites, such as trailheads, visitor centers, and campgrounds, or at public events, such as farmers markets, fairs, and conferences. In an intercept approach, a HEM team member invites potential participants to participate in the mapping activity. This method can potentially reach more people than a workshop, including those who may not typically participate via other means or in other venues. Intercept approaches may use a paper map and questionnaire, or use a tablet with a mapping application configured for offline use. Intercept approaches can be a standalone or supplemental data collection technique.

Because potential participants are often busy with other activities, such as recreation, family time, or shopping, they tend to have less time and patience for interaction than participants in online or workshop settings. Generally, intercept approaches that require ten minutes or less to complete are most successful. Choosing the right location also plays a role in whether an intercept approach succeeds, and good locations for an intercept approach may not always be obvious. In the Olympic Peninsula study described in Vignette 4, we found that collecting responses on a ferry with a captive audience was very productive. Trailheads also proved to be good locations when participants were approached after finishing their activity. However, we've found that campsites are not good locations for intercept approaches, because many people treat campsites as personal spaces.

Keep in mind that intercept approaches will exclude data from people who lack the physical abilities to access a given location. If data from people who cannot access the intercept site(s) is important for the project's goals, the team will need to identify other ways to reach them.

Benefits of intercept approaches:

- Intercept approaches have the advantage of meeting participants where they are engaging in activities in the area of interest, such as trailheads. The approach can capture people's opinions when their experiences are fresh in their minds.
- A HEM team member is available to help participants use the maps and answer questions that arise.
- If a tablet is used, the data are collected in a digital format and can be used directly in a GIS. Internet connectivity during data collection is not required.

Challenges of intercept approaches:

- Because intercept approaches typically take place outdoors, they may be negatively affected by environmental conditions. Paper maps are difficult to use in rainy and windy conditions. Tablets are difficult to use in bright sunlight. Inclement weather conditions may also contribute to reducing the number of potential participants.
- Participants may find it hard to type responses or mark points on tablets which do not have a full-size keyboard or mouse.
- Like workshops, intercept approaches are less useful than online approaches for reaching broad or far-ranging audiences. They also require people to administer the questionnaire.
- If paper maps are used, the data collected will still need to be digitized.

Vignette 4: The Olympic Peninsula Visitors Survey, An Intercept Approach[7]

Figure 4: Using the intercept approach at a visitor center on the Olympic Peninsula. Image credit: David Banis.

Building upon the Olympic Peninsula project described in Vignette 3, Portland State University researchers designed an intercept survey to collect data from visitors to the peninsula. Funded by the Mazamas, a non-profit mountaineering organization, the goal was to determine how landscape values and the nature and intensity of activities vary between visitors and residents.

During the summer of 2012, we collected intercept survey responses at 15 locations using a 2'x2' paper map paired with a page of questions about values, activities, and demographics. These locations included five visitor centers, four campgrounds, four trail access points, and the ferry crossing from Seattle to the Olympic Peninsula. A typical survey would take no more than ten minutes. First, the participants marked up to five meaningful places on the map using points, lines, or polygons, and then assigned the top three values they associated with each marked location. Participants also included the location's name and listed the activities they do there. They then answered questions about their frequency of visits to the Olympic Peninsula, length of visits, and overall experience with national parks and forests. Finally, the participants were asked to provide demographic information, including zip code or country, age, gender, and education.

7 Todd, A. 2014. Mapping Sociocultural Values of Visitors on the Olympic Peninsula, Washington. Dissertations and Theses. Paper 1637. https://doi.org/10.15760/etd.1636

3.3 Online Interactive Map Applications

An online, interactive map is an increasingly popular approach for collecting HEM data. Google Maps is an example of an interactive map where users can pan to see areas on the map that were not initially on the screen, or zoom in and out to display varying levels of detail at different scales. To collect HEM data, participants need tools that can create and annotate spatial data. An interactive map with this additional functionality is called a map application. Interactive maps and interactive map applications are distinct tools, despite the two terms' interchangeable usage.

Note that simply pairing an online questionnaire with a reference map image is not the same technique. This approach requires relying on place names for creating spatial data, because a reference map image cannot be annotated by the user. However, place names are often too general or vague to accurately locate. Many locations may have common names shared with other places, such as Blue Lake or Deer Creek, or are referred to colloquially, such as Old Elks Picnic Grounds. Moreover, the user needs multiple documents open on a screen to take the questionnaire if a map image is used, which increases unreliability.

Benefits of online interactive map applications:

- Pairing online interactive maps with online questionnaires facilitates reaching larger or far-ranging audiences since online participants do not need to be local.
- Online map applications require fewer data processing resources because the data transfers readily into a GIS.
- Some online map applications can take less effort to create than a paper map used in a workshop or intercept approach.

Challenges of online interactive map applications:

- Audiences may lack access to a computer or the internet, notably in rural areas.
- Participants may feel uncomfortable with online map applications, and unlike with workshops or intercept approaches, real-time technical support is often unavailable. Having more instructions on the application does not solve this issue, because many people do not read instructions.
- Although the general public may know how to use interactive maps, they may have limited familiarity with how to create spatial data on such maps.
- Online interactive map applications are often difficult to use with cell phones.
- Some online map applications may take longer to develop than a paper map. Resources needed for customizing an online map and questionnaire may be significant and burdensome if the agency, organization, or community group lacks in-house skills to develop the application.

Vignette 5: The Central Oregon Online Interactive HEM Application[8]

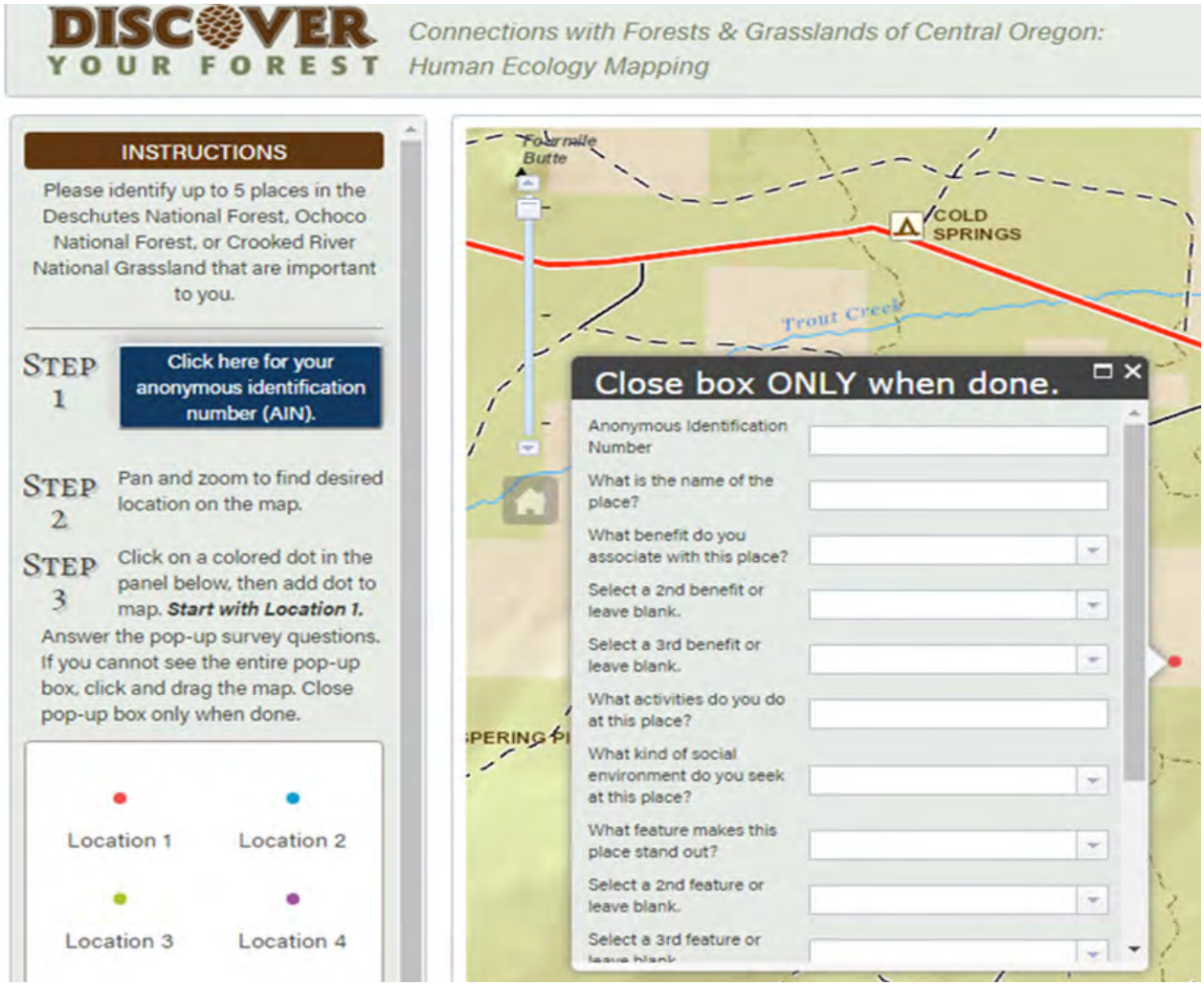

Figure 5: User interface for the custom online interactive map application built to collect and annotate point data for the Central Oregon HEM project. Image credit: David Banis.

The Central Oregon HEM project, which took place between 2015 and 2017, was designed to collect data from the public regarding valued places in the Deschutes National Forest, the Ochoco National Forest, and the Crooked River National Grassland for use in the revision of a forest plan. Portland State University, the Deschutes and Ochoco National Forests, Region 6 of the USFS, the USFS Pacific Northwest Research Station, and Discover Your Forest, a non-profit organization, formed a partnership to create the online mapping application. Discover Your Forest's website hosted the link to the online data collection tool.

8 Banis, D., R. McLain, A. Milligan, K. Harrell, and L. Cerveny. 2019. Socio-Ecological Interactions in the National Forests and Grasslands of Central Oregon: A Summary of Human Ecology Mapping Results. Occasional Papers in Geography No. 8. Portland State University. http://archives.pdx.edu/ds/psu/31028

The online tool had two components: a mapping application and a follow-up questionnaire. The mapping application instructed users to navigate a three-scale map (where the three scales represented the entire forest, forest districts, and smaller recreation areas), drop a point marker, and then annotate a pop-up box with questions for up to five locations that were important to them. Users were asked to identify important places by name and describe the benefits and features associated with that place, what activities were done at that place, and what the perceived threats were to that place. After completing the mapping activity, participants were directed to a non-spatial questionnaire that asked a series of demographic and user attitude questions about public land management.

The HEM application was made available to the public in October 2016 and closed in October 2017. The team also created an offline version of the tool for use on tablets. In summer 2017, the tablets were used to engage the public at a series of public events and at popular outdoor recreation locations such as lakeside resorts.

Vignette 6: The Routt County Pilot Study Using ArcGIS Online Survey123

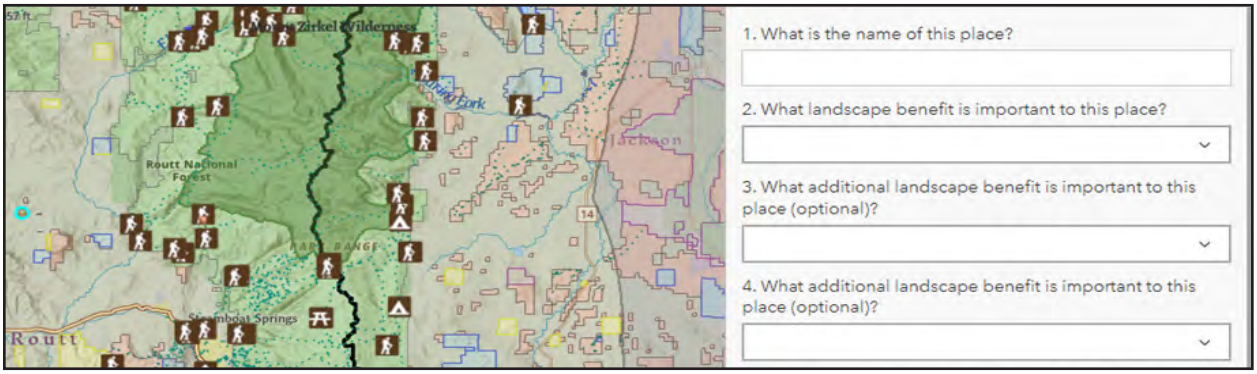

Figure 6: An image from the Survey123 application showing the pre-styled map and questions built for the Routt County project. Image credit: David Banis.

Using lessons learned in the Central Oregon HEM project, a pilot web application was developed for future forest plan revisions and then tested by the Routt Recreation & Conservation Roundtable (RRCR) in Routt County, Colorado during the spring and summer of 2022. This project was one component of a larger project conducted in partnership with the USFS Rocky Mountain Research Station and Gage Cartographics to identify and prioritize ecosystem benefits and to map those benefits using HEM. The web application was designed to collect input from the public about landscape benefits, uses, and priorities across all public lands in Routt County. The intent was to make the pilot application available to the broader public later after evaluating its viability for HEM data collection.

The HEM team selected the pre-styled National Geographic map available through the ArcGIS Online program, because it provided good topographic detail and labeling of natural geographic features at multiple scales. Additional layers were added to the map for context, such as recreational opportunities, trails, and land management of the area surrounding the forest.

The web application itself had several components: an exercise that employed Q-methodology to explore opinions about public land management and planning, a demographics questionnaire, and two mapping exercises that used ArcGIS Online's Survey123 app. The first mapping exercise asked participants to mark points on a map of Routt County and then assign landscape benefits to those places, as well as additional information about the uses of these places and what might threaten one's experience there. The second mapping exercise asked participants to use a separate map to identify areas in Routt County that are acceptable/appropriate or unacceptable/inappropriate for future development of recreation amenities (e.g., trail systems, or facilities). For the second map, participants could indicate places using points, lines, or polygons.

4.0 Developing a HEM Application

4.1 Assembling the Project Team

A HEM project has many parts, and a good team can make a difference between running a solid engagement that yields sufficient, high-quality data, and one that does not. Assembling a project team with complementary areas of expertise ensures that all the necessary skill sets are available to run a solid project. It is important to have one or more members with each of the following characteristics:

- Experience in social science research, including research design and/or questionnaire development, and public outreach.
- Knowledge of and familiarity with resource management issues, with on-the-ground geographic knowledge in the targeted study area.
- Skill in making paper maps or online maps, and if developing a custom online map application, online map programming.
- Capability in GIS analysis methods.
- Project management skills, preferably with meeting facilitation skills.

Larger projects may benefit from a dedicated project coordinator. The project coordinator's role will vary, but it typically includes facilitating communication between team members and between the team and agency leadership, keeping team members accountable for fulfilling their responsibilities, and ensuring that the project team sticks to its timelines.

Every project needs a timeline to ensure follow-through on action items. Building plans for making schedule adjustments, developing contingency plans, and communicating these changes is important.

4.2 Designing the Inquiry Tool

Typically, each project will have its own unique set of questions. Questions and answer choices should always be easy to see, read, and understand. When choosing questions and how many to ask, follow these general guidelines:

- **Know your audience.** Tailor questions to consider your audience's:
  - Level of expertise with the subject matter.
  - Literacy level or need for language support.
  - Interest or personal stake in the subject matter.
  - Availability and willingness to spend time answering the questions.
  - Comfort with the mapping technology.

- **Understand how you intend to analyze the responses.** Before creating the questions, sketch out examples of the types of maps and other graphics you would like to produce. Ask your questions so that you can collect the responses needed to create the desired work products and visuals.
- **Strike a balance between question quantity and quality.** If marking the map and answering the questions takes too long, participants may abandon the activity midway, or they may rush through the activity without taking time to locate places accurately on the map or reflect on their answers. On the other hand, if the number of questions asked is too few, the responses collected may not meet the project's goals. Testing the number of questions on volunteers with a range of experiences in the study area is useful for gauging whether you're asking too many or too few questions, and whether the questions asked will yield the type of responses you desire.
- **Avoid leading questions.** Leading questions are questions that are phrased in ways that encourage a particular answer. For example, the question, "Do you feel this campground is too crowded?" could bias the participant toward answering "yes." A more neutral approach would be to ask, "Which of these conditions best describes the campground for you?" and then provide the participant with a range of choices.
- **Address a single concept in the question.** Beware of questions in which you are inadvertently asking more than one question. Keeping questions and answer options short will help.
- **Consider what response formats to use.** Formats for responding to questions include pick lists, open-ended responses, and Likert scale ratings. Pick lists are generally easier for both the respondent and for data analysis. However, the respondent may find the pick list choices are inadequate. Open-ended responses often yield more detailed information. However, these responses may be time-consuming for participants to respond to and will take more time to analyze. Finally, Likert scale rating questions may be difficult for participants to respond to meaningfully if the questions are too vague, and this difficulty will be reflected in data analysis.
- **Review your language choices.** A good approach for designing effective HEM questions is to write in plain language.[9] Plain language may make it easier for participants to understand what is being asked, as well as make it easier to translate questions into additional languages. When translating questions, use a translator who is familiar with the terminology being used.

9 For guidance on how to write or speak in plain language, see the federal government's plain language website at https://www.plainlanguage.gov/.

- **Make it accessible.** If the HEM map and questions will be used by a federal agency, materials must meet the requirements of section 508 of the Americans with Disabilities Act (ADA), which incorporates the Web Content Accessibility Guidelines (WCAG) by reference.[10] Key considerations include designing for literacy levels; language differences; cognition (ability to understand the HEM process, instructions, and the meaning of questions); vision impairment (e.g., colorblindness, or difficulty reading a computer screen or paper map under various lighting conditions); hearing impairment (e.g., difficulty hearing spoken instructions); and mobility impairment (e.g., difficulty pinpointing a spot on a map using a mouse or fingertip). Addressing accessibility needs may also improve the quality of participants' responses.

4.3 Designing the Map

What should one consider when designing a map for use in data collection? Whether designing a paper map for workshops or intercept approaches or an interactive map application for online use, a map needs to provide enough features and labels for context so that map users can find important locations, especially in rural and undeveloped landscapes. However, the map should not provide so much information that it becomes cluttered and hard to read. Because these maps do not typically include a legend, all information included on the map needs to be easily understood or labeled appropriately with easy-to-see typefaces. Using symbols that people are likely to understand is critical. For example, using the color blue for lakes and rivers and the colors brown or black for roads is intuitive for most map readers. Pictographic symbols, such as a tent to indicate campgrounds or a picnic table to indicate picnicking sites, can be helpful, but one should not assume that understanding these symbols is universal. Other symbology, such as the contour lines commonly used on topographic maps to show elevation, may not be well understood by the general public.

In addition, there are other important, unique design decisions to consider:

- **Designing a paper map.** Designing a paper map for a workshop can be quite different from designing one for interactive display. Paper maps are designed at one particular scale while interactive maps can show a varying amount of detail depending on the zoom level of the map. The size of a paper map might be driven by how many people will be gathered around the map in a workshop, but also by the complexity of the area being mapped. The map designer must decide which features, both natural or human-built, are appropriate to symbolize or label on the map, and which features should be excluded. Labeling

10 Section 508 of the Rehabilitation Act - 29 U.S.C. § 798. For more information about section 508 requirements see https://www.section508.gov/create/.

features on the map may influence places that participants mark, but the absence of labels can make a map difficult to read and interpret. Therefore, a balance must be achieved between too many and too few labels.

- **Designing an interactive map.** Whether using a pre-styled map or a custom-designed map, the first step is to determine what content the users will see on the map. The easiest choice is to adapt a pre-styled map, such as those available through GIS software like ArcGIS, because most of the design work is already done. Additionally, these maps work anywhere in the world and are not limited to the area of interest. However, a user can pan anywhere they choose and zoom to multiple scales, and in the process, may navigate away from the area of interest and get lost on the map. Vignette 6 describes a pre-styled map.
- **Creating a custom map.** Some interactive HEM projects may be better served by creating a custom map for data collection, because it can be tailored to the project goals and audience. A custom map shows only the area of interest and limits the number of scales for zooming, focusing users' attention better than when using a pre-styled map. When building a custom map, remember that each zoom level requires its own level of detail, including datasets and symbols. For example, the map may show only major forest roads when zoomed out but minor roads when zoomed in. The downside of using a custom map is that the design work is labor-intensive and may require hiring someone with the special skills to create the map.

All maps should be verified for accuracy and relevance. Sometimes available data layers may have inaccuracies. For example, a data layer may show roads and campgrounds as open when they are actually closed. To minimize inaccuracies and to ensure that relevant features are included, meet with people who are familiar with the study area. This will help you include locally relevant navigational features and names, which will improve the spatial accuracy of your data.

After designing the interactive map, participants will need a way to create spatial data and a way to annotate those features. Although interactive map applications can be configured to allow users to draw points, lines, and polygons, points are by far the easiest for users to create. Lines and polygons may provide more detailed data but are more time-consuming for map users to create than points. Moreover, if map users do not draw lines and polygons with enough detail, the data can be hard to interpret during data analysis.

Finally, a multi-user editable database is needed to store all data added to an interactive map application. This database must be stored on a server that makes it web accessible. The easiest way to create the database is to use ArcGIS Online, which does not require programming skills. Programs such as ArcGIS Online

also work well for building interactive map applications, but they are limited to preconfigured options. Building a custom map application will require knowledge of programming languages such as JavaScript, HTML, or CSS.

4.4 Piloting the HEM Application

Testing a HEM application with a small set of users before launching the application is a useful way to catch errors and usability problems. Include the project team in the pilot so they better understand the user experience, what the application may or may not capture, and how long participation may take. Most importantly, have individuals who are not directly involved with the project test the map and respond to the associated questions. Conducting an in-person usability evaluation with six to ten people and revising the application based on user feedback can help ensure that the final version of the tool will not present barriers that cause users to become frustrated. Roth and Harrower provide useful pointers for how to design a usability evaluation for an interactive mapping application.[11]

5.0 Analyzing HEM Data

A variety of spatial analysis approaches can be employed, and the specific techniques used will depend on whether the spatial data collected are points, lines, or polygons. Although GIS is often thought of as a quantitative tool, many questions asked in a HEM project require qualitative analysis. One can think of these spatial analysis tools as "quantifying the qualitative." Spatial analysis is more often than not non-linear, iterative, and reflexive as the data are explored. It is important to take into consideration the nature of the data created, such as accuracy, but also the political and social context at the time of data collection. The following discussion outlines some considerations for analysis of HEM data.

Often, spatial data are collected as points only, but they can also include lines or polygons. Points may represent both specific locations, such as a campground, or much larger places, such as a ski resort, or even an entire wilderness area. Lines representing features such as rivers, or polygons drawn around an area of interest, such as a lake basin, can be more accurate than points but only if they are drawn with some level of precision. Although using a point to represent a much larger area can be misleading, a coarsely-drawn or overly-generalized polygon can also misrepresent an area of interest. Since the accuracy of data collected for HEM is difficult to assess, one should assume that the spatial data is only generally accurate and keep this in mind when choosing analysis techniques and presenting

11 Roth, R. and M. Harrower. 2008. Addressing map interface usability: Learning from the Lakeshore Nature Preserve interactive map. Cartographic Perspectives 60: 46-66. doi.org/10.14714/CP60.231

results. The approaches used to analyze spatial data vary depending on the type of geometry used and the scale of analysis.

Analysis can be facilitated by collecting attributes associated with a particular location using clear pre-determined categories, such as a list of possible landscape values. If certain attributes from the questionnaire were collected as open-ended responses, these data fields will need to be categorized for analysis. For example, respondents often list many highly specific activities which can be grouped into broad categories to facilitate spatial analysis (e.g., water sports, instead of canoeing, swimming, and stand-up paddling separately). Categorization is often necessary because a minimum of 30-50 features in each subset of data is required to perform spatial analysis.

A common spatial analysis technique for points is to use kernel density calculations to show where points are concentrated (i.e., hot spots). The kernel density analysis shows how densely the places marked by the participants are spread out over the landscape. Higher densities indicate areas that were marked more often than others. See Figure 7 for an example of such a result. The actual density is dependent on the number of points used for the calculation and is not necessarily comparable from map to map.

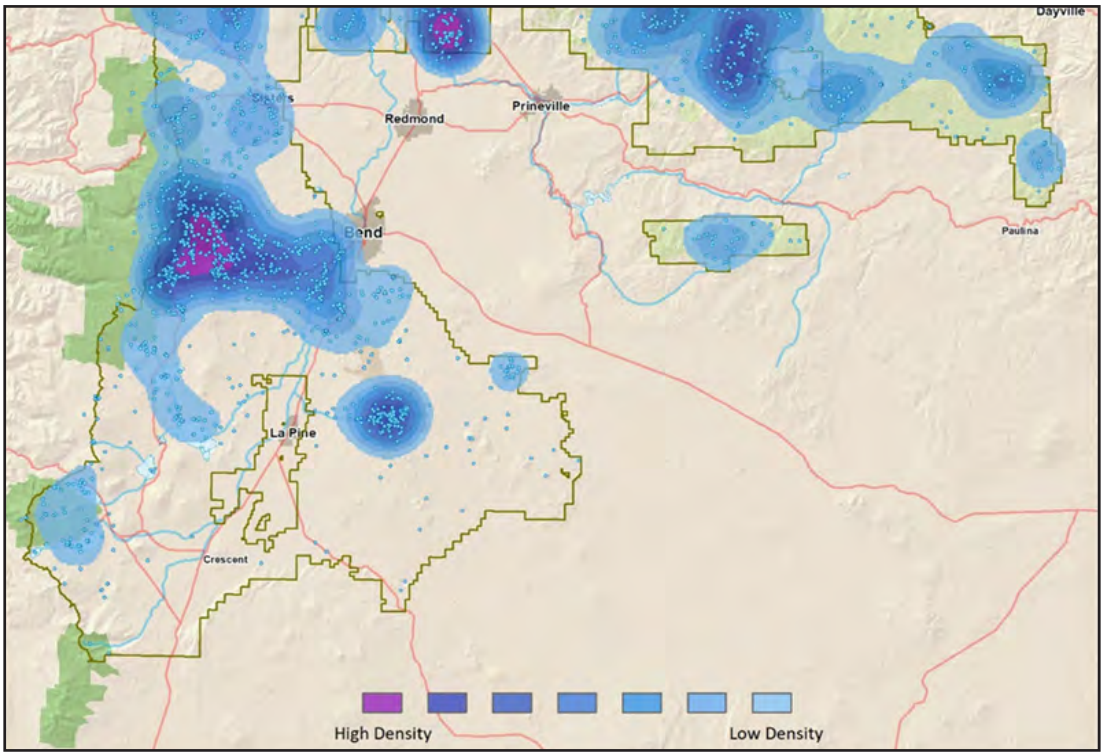

Figure 7: Density of all points placed by participants for Central Oregon HEM project.[12]

12 Banis, D., R. McLain, A. Milligan, K. Harrell, and L. Cerveny. 2019. Socio-Ecological Interactions in the National Forests and Grasslands of Central Oregon: A Summary of Human Ecology Mapping Results. Occasional Papers in Geography No. 8. Portland State University. http://archives.pdx.edu/ds/psu/31028

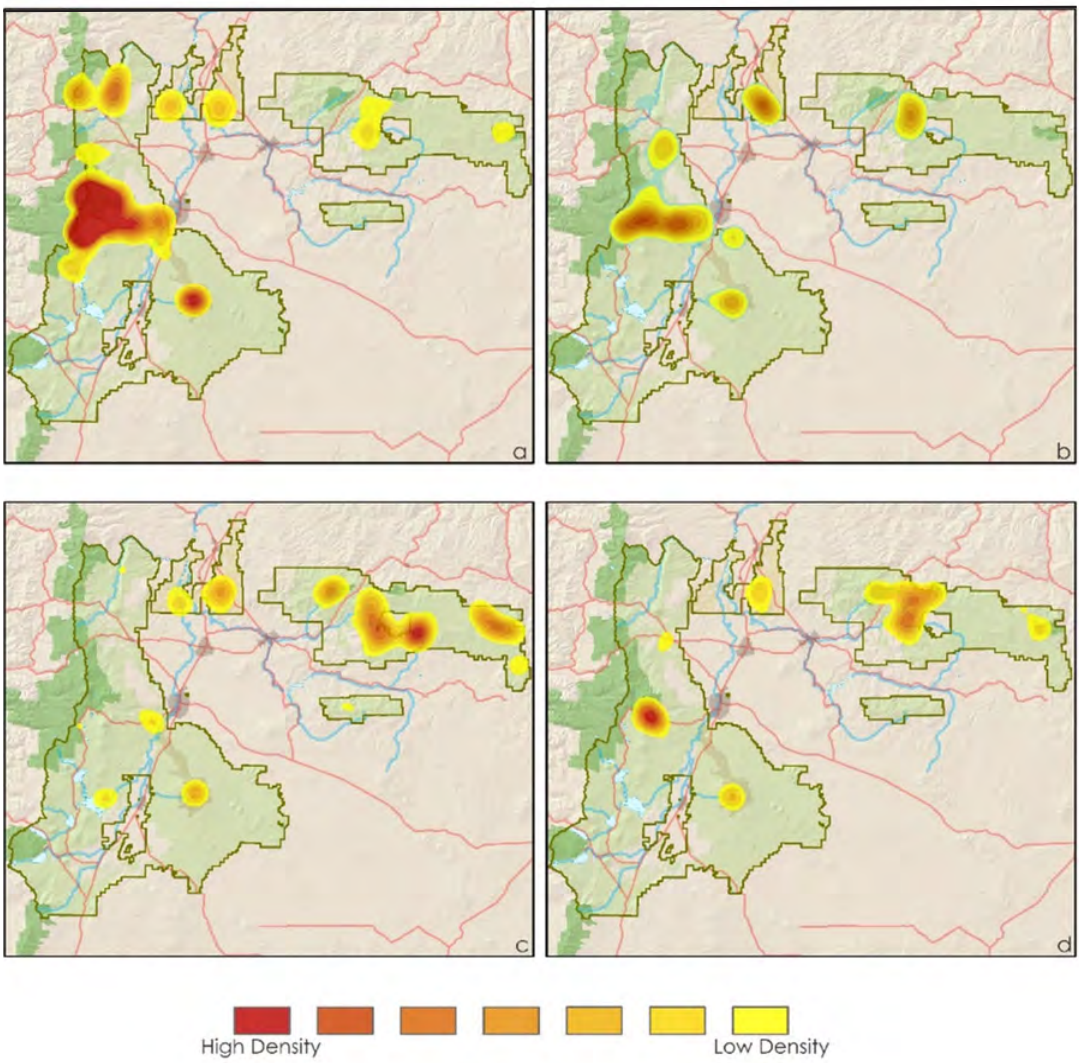

Figure 8: Density of points for select threats: a) Crowds; b) Other User Conflict; c) Natural Resource Management; d) Motorized Recreation. Data collected for Central Oregon HEM project.[13]

It is important to disaggregate the collected data based on certain attributes, such as activity types, benefit types, and demographics, including gender, socioeconomic status, and more. Figure 8 shows where there are concentrations of four different perceived threats to the environment. Simply looking at spatial patterns in the entire dataset may obscure interesting spatial patterns associated with smaller user groups. In the process of disaggregating data, the priorities of particular communities can be highlighted. Some collected attribute data may be best communicated with charts rather than maps. For example, charts of demographics can illustrate who actually marked places on the map and answered the associated questions, as well as show which groups might be missing.

13 Banis, D., R. McLain, A. Milligan, K. Harrell, and L. Cerveny. 2019. Socio-Ecological Interactions in the National Forests and Grasslands of Central Oregon: A Summary of Human Ecology Mapping Results. Occasional Papers in Geography No. 8. Portland State University. http://archives.pdx.edu/ds/psu/31028

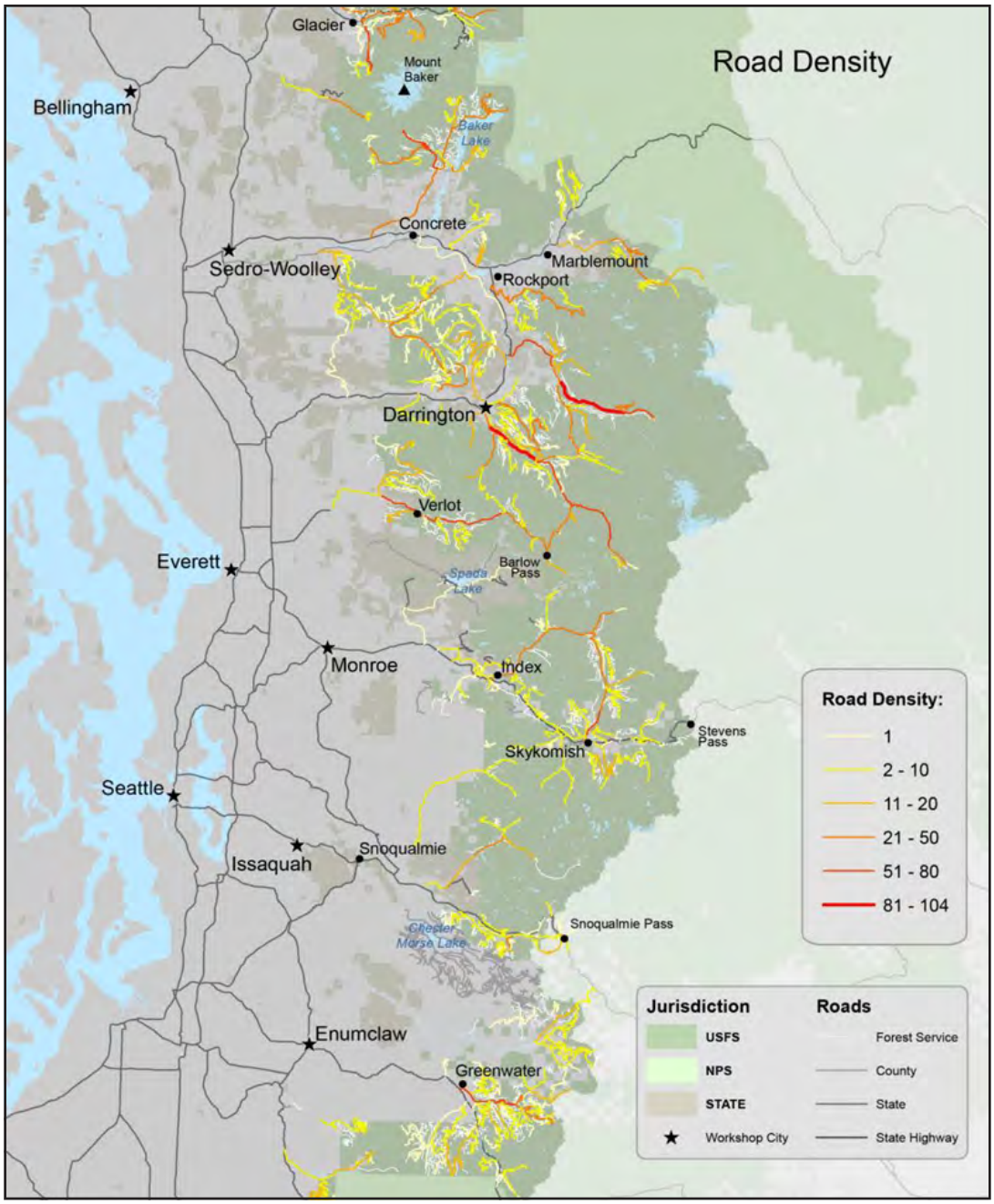

Figure 9: Road density from Mount Baker-Snoqualmie National Forest Sustainable Roads Strategy HEM questionnaire.[14]

If line or polygon data have been collected in the mapping activity, then an overlay analysis can be performed. Figure 9 shows the results of such an analysis where the number of overlapping road segments marked by participants was calculated to show the density of important roads. A similar process can be used with polygon data to calculate the number of overlapping areas, creating a result that looks much like a kernel density calculation.

14 Todd, A. and D. Banis. 2015. Analyzing public participation data for transportation planning in the Mt. Baker-Snoqualmie National Forest. Presentation at the GIS in Action Conference, Vancouver, WA, May 2015.

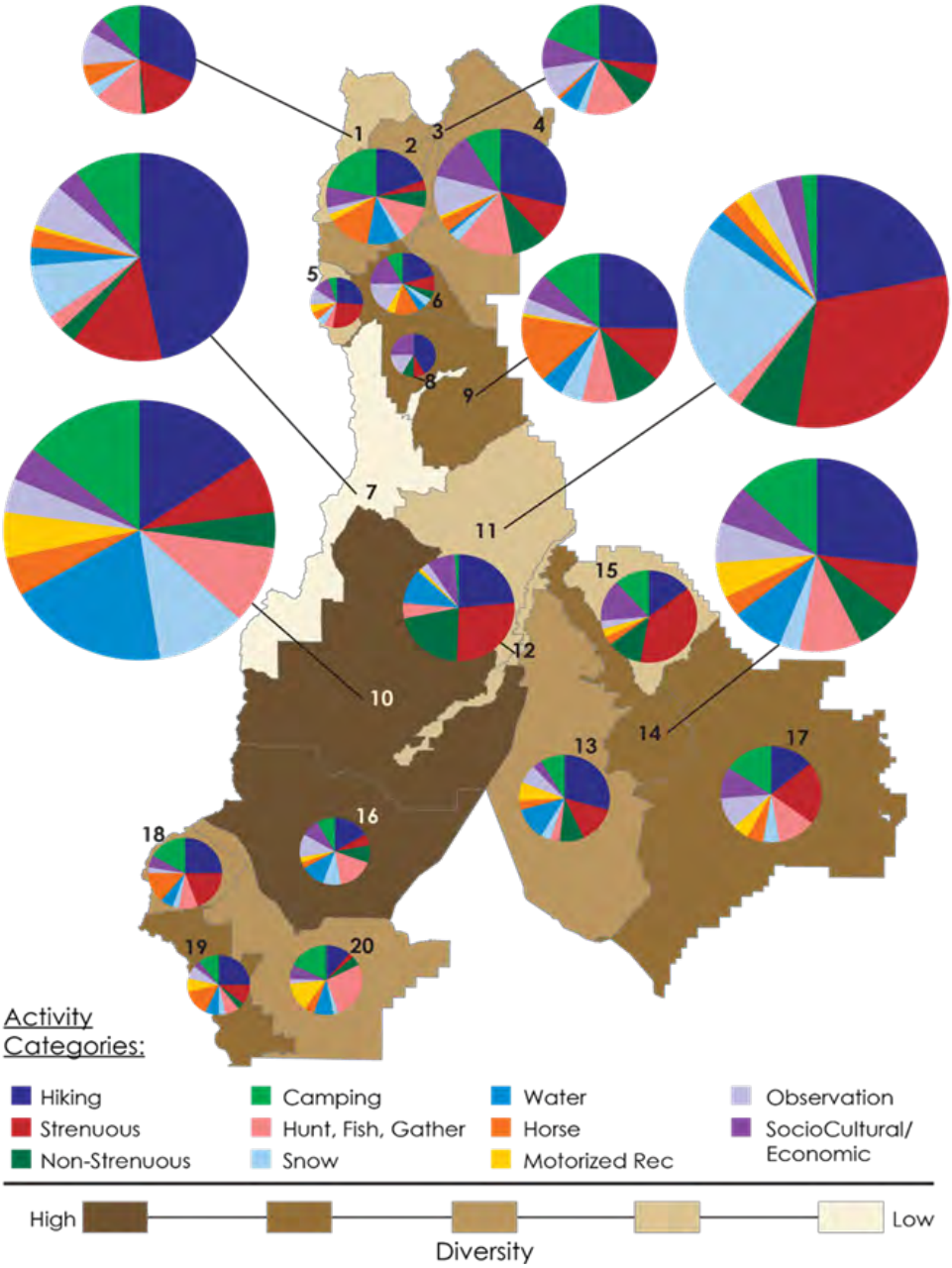

Figure 10: Proportional pie chart of diversity of activities in Deschutes National Forest.[15]

Another spatial analysis technique can show the diversity of uses in a particular area. These calculations adapt species diversity indexes, e.g., the Inverted Simpson index. Diversity indexes take into account both the variety of uses and balance of those uses. For example, variety captures how many different activity categories are noted for a given area, and balance shows how evenly distributed those different activities are. See Figure 10 for an example of such a result for specified recreation zones.

15 Banis, D., R. McLain, A. Milligan, K. Harrell, and L. Cerveny. 2019. Socio-Ecological Interactions in the National Forests and Grasslands of Central Oregon: A Summary of Human Ecology Mapping Results. Occasional Papers in Geography No. 8. Portland State University. http://archives.pdx.edu/ds/psu/31028

6.0 Reporting Back Results

The final phase in any HEM project involves sharing the mapping results with the people or groups who requested, contributed to, or are likely to use the data. Reporting back may take a variety of forms. For example, the Olympic Peninsula project team (see Vignette 3) first reported back their results at a meeting with ranger district staff. The team later shared the results, together with findings from a follow-on intercept approach (see Vignette 4) in the same area, at two stakeholder group meetings. For the Mount Baker-Snoqualmie project (see Vignette 1), the project partners reported back the results during a series of community listening sessions. For the Central Oregon HEM project (see Vignette 5), the team organized a day-long workshop with USFS staff to report back the results and demonstrate the types of analyses that could be done with the data. In some cases, reporting back can be structured to provide practical benefits for the participants (see Vignette 7).

Reporting back is an art in itself. Unless the participants in the report-back sessions are familiar with GIS-related terminology, the results need to be described using plain language. Maps should be relatively simple, with only the most essential features included, along with clear and legible legends and symbols. In addition to being respectful of those who have provided data, report-back sessions are useful for refining data interpretation because they give HEM participants an opportunity to validate the findings and explain patterns that they or the analysis team find puzzling.

Vignette 7: Forest Product Harvester Mapping Workshop[16]

Figure 11: Forest products harvesters mapping their work and recreational uses on the Olympic Peninsula. Image credit: Rebecca McLain.

In 2011, the USFS Pacific Northwest Research Station and the Institute for Culture and Ecology organized a HEM workshop for harvesters collecting floral greens and wild mushrooms commercially on the Olympic Peninsula. The project team worked closely with a local immigrant association to design the workshop, which was held in Spanish.

In the workshop, participants mapped important recreation and harvesting use areas using sticker dots. They also identified key concerns related to their outdoor activities. Concerns included immigration law enforcement, forest safety, and compliance with harvesting regulations.

In 2012, the harvesters met with land managers and law enforcement officials to brainstorm approaches for addressing the concerns identified in the mapping activity. Because harvesting and hunting seasons overlapped, one important concern was that harvesters were at risk of being shot accidentally by hunters. To mitigate this risk, the land management agency developed "harvester working" signs to be posted in harvest areas during hunting season so that hunters would know that harvesters are likely to be present.

16 Biedenweg, K., L. Cerveny, R. McLain. 2014. Values mapping with Latino forest users: Contributing to the dialogues on multiple land use conflict management. Practicing Anthropology 36(1): 33-37.

7.0 Closing Remarks

After more than a decade experimenting with different approaches to HEM we have concluded that it is a powerful tool for collecting sociocultural data in a format that can be readily integrated with biophysical data in a GIS database. We have found HEM to be a flexible tool that can map human-environment connections at different scales and contribute useful data for many types of planning processes. Moreover, it can readily be adapted to fit the project team's budget, skills, staffing, and tailored to different types of data providers and users. This manual summarizes the lessons we learned through trial and error, highlighting practices that result in good quality data, as well as those practices that should be avoided. In doing so, the manual provides a basic foundation of information about HEM that your team can draw upon to design and implement successful HEM projects. For those wishing to learn more, we have provided a list of articles and documents from the projects we've described in this manual, as well as a list of articles about similar types of projects others have done.

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