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Mapping Landscape Values: Issues, Challenges and Lessons Learned from Field Work on the Olympic Peninsula, Washington

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In order to inform natural resource policy and land management decisions, landscape values mapping (LVM) is increasingly used to collect data about the meanings that people attach to places and the activities associated with those places. This type of mapping provides geographically referenced data on areas of high density of values or associated with different types of values. This article focuses on issues and challenges that commonly occur in LVM, drawing on lessons learned in the US Forest Service Olympic Peninsula Human Ecology Mapping Project. The discussion covers choosing a spatial scale for collecting data, creating the base map, developing data collection strategies, the use of ascribed versus assigned values, and the pros and cons of different mapping formats. Understanding the common issues and challenges in LVM will assist policy makers, land managers, and researchers in designing a LVM project that effectively balances project goals, time and budgetary constraints, and personnel resources in a way that ensures the most robust data and inclusive public participation.

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Introduction: Landscape Values Mapping

Landscape values mapping (LVM) is increasingly being used to collect spatial information about the meanings that people attach to places and the activities associated

with those places (Donovan et al., 2009; Fagerholm and Käyhkö, 2009; Fagerholm et al., 2012; Hall et al., 2009; Raymond et al., 2009; Tyrvaïnen, Makinen, and Schipperijn, 2007; Zhu et al., 2010). Landscape values maps are useful tools for identifying and visualizing human–environment connections that entail complex and often localized place-based relationships not easily captured by using secondary data [e.g., United States (US) Census] or written surveys. LVM provides geographically referenced data on areas of high value (*density*) or associated with different types of values (*diversity*). These data can also be overlaid with other biophysical, land tenure, and land use layers to help land managers understand the variety of landscape values, how proposed activities at a particular site are likely to affect users, how to target resources efficiently, and where potential value conflicts may occur.

LVM draws on an extensive body of theory and empirical research on the concept of sense of place and the relationship between sense of place and cognitive maps. Sense-of-place theorists argue that people use their own personal experience, as well as embedded attitudes and ideologies, to assign meaning or particular values to places (Proshansky, Fabian, and Kaminoff, 1983; Tuan, 1977; Williams and Stewart, 1998). The goal of values mapping is to collect sense-of-place data that show the location and intensity of the different kinds of values that people associate with particular landscapes. A wide variety of LVM methodologies have been employed, including freehand sketch maps or mental mapping, hard-copy base maps coupled with key informant interviews, or digital mapping technologies such

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as GIS (geographic information systems) and Internet-based mapping applications.

Because LVM collects values-based data, the methodology is considered a public participatory process. It can also be complicated by the inherent subjectivity, fuzziness, and changeability of human values. While addressing these complex issues is beyond the scope of this article, a report published by the International Fund for Agricultural Development (2009) provides an excellent synopsis of good practices in participatory mapping. In addition, Wright's (1942) classic article highlights the subjective elements of map making, still relevant today. His discussion of cartographic issues such as simplification, amplification, symbolization, and (often inappropriate) quantification of mapped data will help LVM researchers and practitioners in understanding the important relationship between the base map and the spatial content produced by the mapping participants, as well as in interpreting the results of the mapping endeavor.

LVM helps environmental planners by providing data that can be used to integrate human values into place-based planning (Brown, Reed, and Harris, 2002; Cheng, Kruger, and Daniels, 2003; Endter-Wada and Blahna, 2011; Farnum and Kruger, 2008). Endter-Wada and Blahna (2011) argue that understanding the human dimensions of land management is necessary in order to effectively design management plans, avoid possible conflicts, conduct collaborative learning, and support stewardship activities. LVM has been used for purposes such as forest management, urban greenspace planning, wildland conservation, recreation facility development, and protection of culturally or spiritually relevant places. [For a detailed discussion of values mapping, see McLain et al. (2013b).]

Though many different strategies have been used in LVM, there are issues and challenges that should be considered in all LVM projects. The following discussion focuses on some of the challenges and lessons learned from the US Forest Service Olympic Peninsula Human Ecology Mapping (OP-HEM) Project. Specific topics include choosing a spatial scale for collecting data, creating the base map, using ascribed (typologies) versus assigned (open-ended) values for the mapping activities, and developing data collection strategies and mapping formats. The case study described employs a strategy that collects data that can be integrated into a GIS and is used for illustrative purposes. However, the discussion of the issues and challenges does not exclusively refer to a GIS-based data collection strategy.

Project Background

In 2009, the US Secretary of Agriculture introduced the “all lands” approach to management and assessment of the national forest system (US Department of Agriculture, 2009). This approach emphasizes collaboration and engaging the public early and often to build a common understanding of the roles, values, and contributions of national forest lands within a broader interconnected landscape. Additionally, the 2012 US Forest Planning Rule requires the incorporation of sociocultural data, gathered through a public participatory process, in order to inform the forest planning process (US Department of Agriculture/US Forest Service, 2012). Agencies engaged in planning and environmental assessment benefit substantially from georeferenced sociocultural information that can be integrated with economic and biophysical data at various spatial scales. LVM, for example, employs best practices in participatory mapping to gather place-specific data about social, economic, and cultural values associated with the forest. It can be applied in all three stages of forest planning (assessment, plan development, and monitoring) where data is used to assess current conditions, target management strategies, and monitor results.

To address the need to adopt an “all lands” approach and meet the requirements of the new Forest Planning Rule, scientists with the US Forest Service's Pacific Northwest Research Station, the Institute for Culture and Ecology, and Portland State University partnered to develop and test a LVM methodology for collecting and analyzing geospatial sociocultural data for land use planning at regional scales. The pilot OP-HEM Project was conducted on the Olympic Peninsula in western Washington State in 2010 and 2011.

The goals of the OP-HEM Project workshops were to collect landscape values data from residents and compile an atlas of the Olympic Peninsula that showed human-landscape connections. The mapping activities were designed to elicit places of importance to residents and spatial locations of activities to help managers gain an understanding of the unique social, cultural, and historical context of the entire Olympic Peninsula. Project objectives included:

- Develop a workshop protocol that provides a practical tool for use in planning and can be replicated by land management agencies in other regions.
- Design a data collection format that is inclusive and takes into consideration a wide spectrum of mapping skill levels.
- Collect data in a way that can be compiled in a GIS format conducive to applying spatial analysis techniques.

- Collect qualitative data that supplement the spatial features represented in the maps, including the reasons a participant values an area, how often the participant visits it, and the kinds of activities enjoyed there.
- Design a format that brings land management agencies and communities together and supports dialogue about landscape values, builds trust, and allows for new avenues of communication between the US Forest Service and the public.

Olympic Peninsula Human Ecology Mapping Approach

The OP-HEM Project employed a facilitated participatory mapping workshop design using hardcopy 3' x 3-foot base maps of the Olympic Peninsula at a scale of 1:175,000. (One inch on the map equals 175,000 inches in the real world.) The facilitated workshop design was chosen (as opposed to a survey or Internet-based design) in order to

provide an interactive forum and face-to-face contact between the agency and the public to encourage communication and trust building per the goals of the project.

A wide variety of recruitment strategies were employed in cities located throughout the Olympic Peninsula in order to attract a participant sample that reflected the demographic characteristics and special interests of the region. Where possible, lists of potential participants were procured through the local Forest Service stations or compiled by using the knowledge of local leaders. Recruitment strategies included direct invitations, notices in local news publications and on radio stations, electronic invitations posted on community calendars, and flyers posted in prominent public gathering places. Specific effort was made to directly invite representatives from the diverse stakeholder groups in each community.

Figure 1 shows the locations of the workshops conducted throughout the Peninsula in 2010 and 2011. For ease of administration and to encourage interaction, workshop

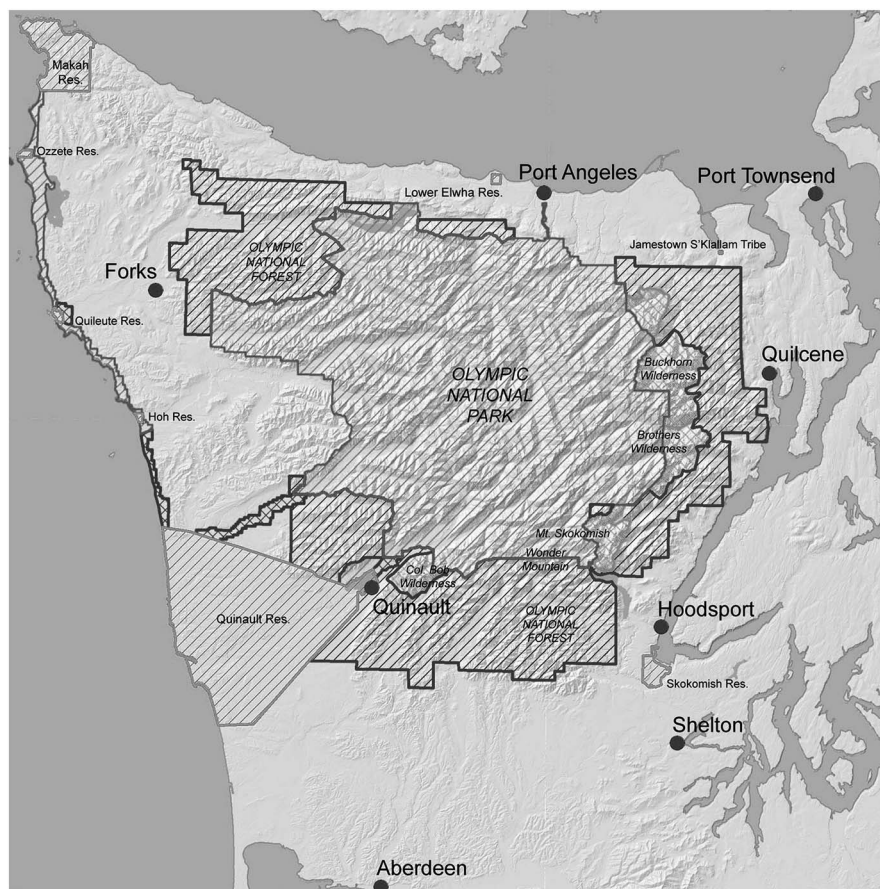


Figure 1. Map of the Olympic Peninsula in western Washington State showing the eight Olympic Peninsula Human Ecology Mapping Project workshop sites and jurisdictional boundaries of the national park, national forest, wilderness areas, and Native American reservations.

participants were assigned to a table of 4–6 persons, with one base map of the Olympic Peninsula overlaid with clear Mylar (as illustrated in Figure 2). Participants used permanent markers to draw features directly on this Mylar. Each participant was given a collated worksheet packet for recording location names, values, and activities related to that location, demographic data, and any other explanatory information they wished to provide. Conversations between participants at a table occurred throughout the exercises, but each table was not expected to reach consensus on places of value. Each participant mapped their features individually.

To capture both landscape values and activities for comparative purposes, the workshops consisted of two mapping exercises—*meaningful places* and *activities*—lasting about 20–30 minutes each. In the Meaningful Places exercise, participants were asked to locate a maximum of five places that had particular meaning for them and to choose one primary value for each place from a standardized list of 14 values. Table 1 describes these value classes. In the activities exercise, participants were asked to identify three outdoor activities they enjoyed on the peninsula and to locate up to five locations where they did each activity. The participants were given a list of activities to consult but were not required to choose from this list. The activities identified by participants during the workshop were compiled and categorized during postprocessing into eight clusters of related activities to facilitate data



Figure 2. Photograph depicting the format of the landscape values mapping workshop that took place in Quinault, Washington, in 2010. Participants drew features directly on Mylar overlaid on a base map of the Olympic Peninsula. The Mylar was scanned, georectified, and the features digitized in a geographic information systems (GIS) environment.

aggregation, mapping, and spatial analysis. These clusters are listed in Table 2. Participants were encouraged to draw whatever geometric form—point, line, or polygon (area)—they felt was appropriate to delineate each place

Table 1. Typology of landscape values provided for participants during the Olympic Peninsula Human Ecology Mapping Project *meaningful places* mapping exercise^a

Landscape value	Description
Aesthetic	I value this place for the scenery, sights, smells, or sounds.
Economic	I value this place because it provides income and employment opportunities through industries such as forest products, mining, tourism, agriculture, shellfish, or other commercial activity.
Environmental quality	I value this place because it helps produce, preserve, and renew air, soil, and water or contributes to healthy habitats for plants and animals.
Future	I value this place because it allows future generations to know and experience it as it is now.
Health	I value this place because it provides a place where I or others can feel better physically and/or mentally.
Heritage	I value this place because it has natural and human history that matters to me and it allows me to pass down the wisdom, knowledge, traditions, or way of life of my ancestors.
Home	I value this place because it is my home and/or I live here.
Intrinsic	I value this place just because it exists, no matter what I or others think about it or how it is used.
Learning	I value this place because it provides a place to learn about, teach, or research the natural environment.
Recreation	I value this place because it provides outdoor recreation opportunities or a place for my favorite recreation activities.
Social	I value this place because it provides opportunities for getting together with my friends and family or is part of my family's traditional activities.
Spiritual	I value this place because it is sacred, religious, or spiritually special to me.
Subsistence	I value this place because it provides food and other products to sustain my life and that of my family.
Wilderness	I value this place because it is wild.

^a Participants were required to choose a primary value from this list for each place they identified on the base map. This typology is adapted from a similar list described by Brown and Reed (2000).

Table 2. List of aggregated activities categories used for analysis of the data for the Olympic Peninsula Human Ecology Mapping Project *activities mapping exercise*^a

Assigned activities cluster	Activities noted on worksheet
Motorized recreation	ATVs (all-terrain vehicles) and other off-road vehicles Motorized boating Water skiing and jet skiing Winter sports (snowmobiling)
Nonmotorized recreation	Backpacking, hiking, walking, and running Bird watching, wildlife viewing, and sightseeing Camping (developed and backcountry) Golfing Horseback riding Organized play (playgrounds/parks) Orienteering and geocaching Outdoor team sports Photography Picnicking, relaxing, and resort use Road or mountain biking Swimming Nonmotorized boating (canoe/kayak) Winter sports (skiing, snowshoeing)
Hunting	Hunting and trapping
Fishing/shellfishing	Fishing (river and coastal) Shellfishing
Foraging	Foraging and gathering (e.g. mushrooms, florals, firewood) Rock, fossil, or shell collecting
Economic	Farming and ranching Logging Mining
Cultural/social/heritage	Visiting cultural/historic sites Ceremonies and traditions Religious and spiritual (vision quests) Meditation
Education/science/observation	Environmental monitoring and scientific research Forest restoration and stewardship Guiding and interpretation

^a These categories were developed from the assigned activities noted on participant worksheets to facilitate further spatial analysis.

they valued. A total of 169 peninsula residents participated in the workshops, resulting in 818 value features and 1,594 activity features.

Challenge 1: Choosing an Appropriate Map Scale for Spatial Data Collection

Collecting primary data on landscape values is often time consuming and expensive. A land manager may be inclined to design a LVM project to gather as much data as possible for as large an area as possible. However, data collected at a regional scale, which provides a broad-based picture of landscape-level patterns, is often inappropriate for making decisions at local scales. Conversely, data collection at multiple local scales can be challenging and time consuming to interpret or aggregate for use in regional-scale planning. Development of clearly stated research questions and data-acquisition goals at the onset of a LVM project is necessary in order to choose an appropriate map scale for spatial data collection.

For example, the US Forest Service all-lands approach makes a strong argument for looking at human–environment interaction as a giant system rather than circumscribed within jurisdictional boundaries. For the OP-HEM Project, a regional scale was selected because that was consistent with the agency’s interest in understanding these regional connections. Using a regional approach shows patterns in resource use that might be affecting land management agencies in different ways. However, a regional scale would not provide information specific enough to fulfill goals or make decisions at localized levels—for example, which trail facilities should be maintained in any given forest management unit.

However, using an iterative process, regional-level mapping projects can provide the data needed for local decisions, such as determining where resources for targeted research or management strategies are best applied. For example, analysis of LVM data can locate areas of high use or potentially conflicting values or activities. Land managers can see where high levels of activities, such as harvesting (e.g., mushrooms or floral greens) and hunting, occur in close proximity. Supplementary mapping workshops, surveys, or interviews can then be targeted in these areas to gather more information about the extent and timing of these uses to assess where additional policing may be appropriate or whether initiating forest safety programs would be helpful. LVM at the regional scale can also identify areas where popular values may be incongruent with land management goals. On the Olympic Peninsula, habitat protection for endangered species may conflict with the economic value (e.g., foraging and timber production) that residents place on forest resources. Locating areas of incongruence helps land managers understand and anticipate localized public resistance to proposed land management plans.

A supplementary, yet important, issue to consider is that the scale of the base map may influence the places people select and the way they draw them. Care must be taken in assuming that an individual may select the same features or draw them in the same way if given a base map at a different scale (Cacciapaglia, Yung, and Patterson, 2012). Anecdotal evidence from the OP-HEM Project workshops suggests that participants may draw larger, more generalized polygon features on a regional map than they might if given the opportunity to locate more specific places on a local map. For example, resident participants were often frustrated by the inability to locate a particular feature on the regional base map, such as a Forest Service road used to access a favorite trail. Consequently, participants often drew polygons that encompassed the general area. On the other hand, some activities or values may simply lend themselves to drawing either large or small polygons. For example, participants locating areas where they prefer to hunt or areas with aesthetic value are likely to draw relatively large polygons. Locating *home*, however, may be drawn with a point. Given these considerations, using a single regional-scale base map may result in a wider range of feature sizes and shapes and, perhaps, a greater tendency to draw polygons rather than points or lines. If the project study area is regional, more geometric specificity may be needed to meet project data-acquisition goals. In this case, using a set of local-scale base maps, rather than a single large regional map, may be warranted.

Challenge 2: Base Maps and Geographic Detail

Good practices in participatory mapping suggest that, when using base maps, care must be taken to limit the amount of predetermined information placed on the map (e.g., features and labels) in order to limit unintended and confounding influences on participant behavior (Alcorn, 2000; Bryan, 2011; International Fund for Agricultural Development, 2009; McCall and Dunn, 2012). Methodologies using mental mapping (Feinberg et al., 2003; Gould, 1970) or sketch maps (Herlihy, 2003) invite participants to create their own maps. However, many government agencies and organizations seek landscape values data that can be integrated into a formal decision process, often in a format that can be incorporated into a GIS. In this case, a prepared base map (either hard copy or Internet based) is required in order to georeference the participant data properly. However, a base map represents a predetermined landscape surface to draw on and thus has the potential to influence participant responses.

In the OP-HEM Project, construction of a base map proved especially challenging. In LVM projects, satellite imagery or

aerial photos have been used successfully to provide an unlabeled georeferenced landscape surface that can be integrated into a GIS (Fagerholm and Käyhkö, 2009; Mather, 2000). However, due to heavy vegetation on the peninsula and the regional scale of the project, using an aerial image was untenable. The image showed few discernible physical or man-made features that participants could use to orient themselves and locate places. To apply the accepted best practices in participatory mapping, the team opted instead for a simple base map constructed by using a hillshade to display topography with minimal feature labels.

However, limited features and labels on the original base map frustrated participants at our first workshop. Although they knew the peninsula well, the simplified base map encompassed a large region and provided few means for participants to locate specific places easily. For subsequent workshops, we changed the base map to provide significantly more labeled features, including beaches, rivers, mountain peaks, state roads, state parks, and other well-known public places. Though providing numerous labels on the base map might have resulted in some unanticipated influence on selected features, our experience in the first workshop indicated that most of the participants were longtime residents, knew the area well, and already had meaningful places in mind prior to locating them on the base map. The labels simply enabled them to find these places more easily. To further minimize any confounding influence from the labeled base maps, we also instructed participants to fill out their worksheets first with the names of their meaningful places and then locate and draw these places on the base map.

More labels on the base map may also be necessary for participants who are unfamiliar with the study area, though the confounding influences may become more pronounced and problematic. A separate, but related, project included a mapping survey of visitors to the Olympic Peninsula that illustrates some of the problems of providing base-map feature detail and labels. Visitors at various tourist sites on the peninsula often commented that they didn't know the region well and were not sure what they valued. In these cases, an *anchor heuristic* may be present resulting in a greater tendency to let the features labeled on the base map determine responses (Kahneman, 2013). As Figure 3 demonstrates, in some surveys the feature labels themselves were circled instead of the actual places.

As our examples illustrate, including a significant number of feature labels on the base maps is often necessary in order to facilitate mapping especially when mapping at a regional scale, but these also increase the potential for unintended

influence and spatial inaccuracies in the data. The goal is to balance the needs and geographic knowledge of the participants with the potential for influence during mapping. This will also reduce the need to deal with data anomalies in the data-processing phase (e.g., compiling the data or digitizing the features into a GIS). In the case of circled labels, for example, there is no way to discern the actual spatial extent of the feature the participant intended to highlight. If the drawn feature is digitized as is, the polygon merely reflects the cartographer's decision on where to place the label. If the actual feature extent is digitized instead, an assumption is being made about the true intent of the participant: Did the participant intend to draw the entire area the label represents or perhaps only a portion? Alternatively, the anomalous polygon can be removed from the data set, though removing data introduces additional sampling issues. [See Brown and Pullar (2012) for a discussion of appropriate sample sizes to account for removed data in LVM projects using polygons.]

The OP-HEM Project opted to mitigate these issues by providing facilitators who watched for potential problems and assisted participants in locating features on the base map. One-on-one and in-depth mapping interviews that solicit detailed descriptions of the valued places can also be

used to cross-check and increase spatial accuracy. When facilitation is not possible, supplementary survey questions that gather information about a participant's familiarity with the area can provide information about the extent to which participants are able to locate features accurately or where map labels or other map details may influence responses and subsequent interpretation of the data.

Challenge 3: Sampling and Data Collection Strategies

Including data collection instruments that gather demographic and other relevant participant data is important in assessing whether the target population has been reached. A different sampling scheme and data collection process may be necessary to incorporate underrepresented groups. For example, despite a comprehensive outreach strategy, demographic information from the OP-HEM Project showed key stakeholders missing from the workshops that included Latinos, young adults and teens, and some special interests. We dealt with this omission by conducting an alternative outreach and data collection strategy to reach Latino forest workers (Biedenweg, McLain, and Cervený, 2014) and used a less structured mapping method (similar to

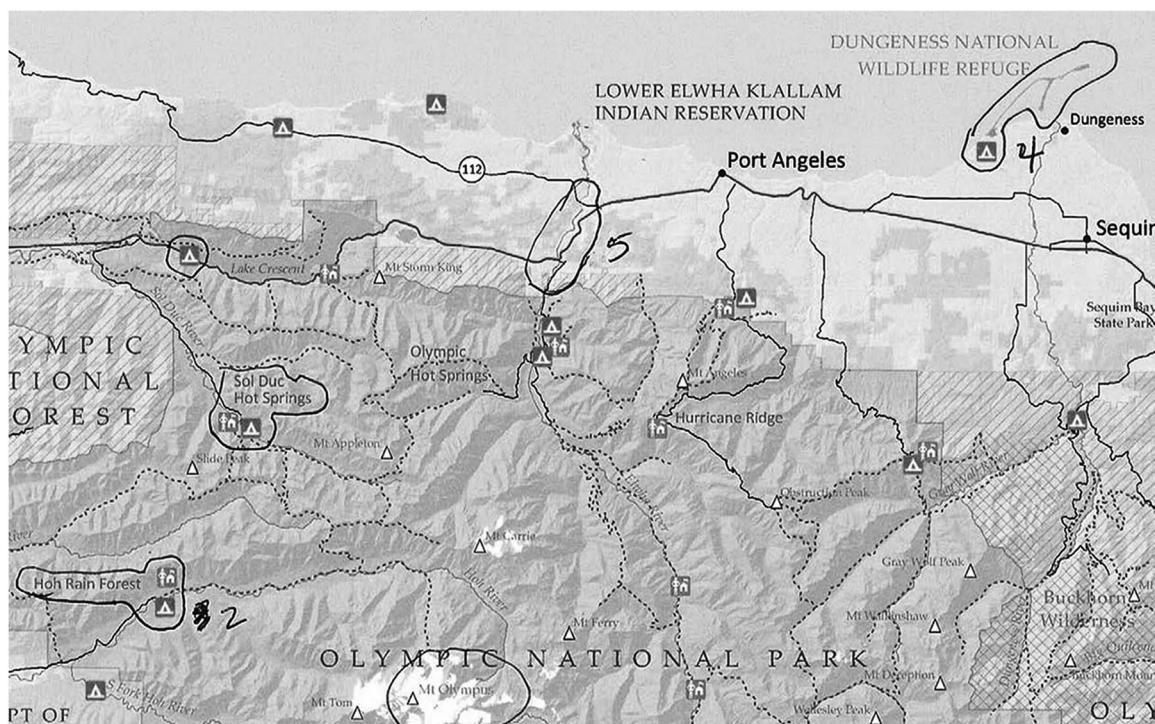


Figure 3. Example of label circling from the related Olympic Peninsula visitor mapping survey. The graphic illustrates problems that may arise due to a phenomenon called *anchor heuristic* (a tendency to let the features labeled on the base map determine responses).

that used for the Olympic Peninsula visitor mapping survey) to attract potential participants attending conferences and meetings of special interest groups.

Self-selection bias is also an issue in many LVM sampling and data collection designs. Workshops, for example, require a substantial commitment in time from participants and may attract those already engaged in regional issues (Craig, Harris, and Weiner, 2002). Mapping surveys by mail often have a low rate of return (Brown and Reed, 2009; Kaplowitz, Hadlock, and Levine, 2004). Internet-based mapping has recently become a cost-effective data collection strategy, but a recent study by Brown and Pullar (2012) indicates that this technique can be biased by a low return rate and a tendency to disproportionately attract men with a relatively high level of formal education.

Which LVM sampling and data collection design is most appropriate depends on balancing the project goals, time frame, and budget. A brief comparison of workshop, written-survey and Internet-based mapping strategies are discussed next.

How Many Stakeholder Groups Need to Be Represented? Is the Size or Randomness of the Sample More Critical Than the Composition of Who Participates?

Workshop logistics tend to impose practical limits on the total number of participants (e.g., space constraints, the need for facilitators, cost of supplies). In the OP-HEM Project, we limited each workshop to about 25 people. Though size may be limited, representation from particular stakeholder groups is more easily achieved by using the workshop design and targeted recruitment strategies. On the other hand, a much larger sample size is possible by using mail or Internet-based survey-mapping methods, but the results may be more biased by low return rates and self-selection.

What Resources Are Available—in Time, Cost, Personnel—for Sampling/Recruitment and Data Collection?

Participatory mapping workshops tend to be more costly, personnel intensive, and time consuming to implement than mail surveys or Internet-based mapping. In the OP-HEM Project, approximately 10–20 hours were spent on recruitment per workshop. Three staff members were required to facilitate each workshop (which entailed about a day and a half for each commitment, including travel and workshop preparation). Other costs included room rentals, plotting large base maps,

and various supplies. Mail or Internet-based mapping strategies, while usually less costly, still require technical staff trained in cartography and/or information technologies to create the map, set up the system, and manage the data as they are received. In addition, adjustments in the data collection instruments (such as the changes made on the peninsula base map as described earlier) are often not possible or can be quite costly or complicated to implement (particularly for modifications to an Internet-based mapping program).

Is Interaction between Participants a Project Goal or a Potential Confounding Influence?

The workshop design provides opportunities for collaborative dialogue among participants and the facilitators and is an effective and efficient strategy when such dialogue is an important project goal. However, conversations among participants in a workshop may influence what valued places someone selects, particularly if sensitive issues or charged politics are involved. For example, opposition by local timber producers to the potential expansion of wilderness areas in the western portions of the Olympic Peninsula is clearly reflected in the results of the OP-HEM Project (McLain et al., 2013a). In many cases, participants at a table did reach a consensus through discussion (either before or during the workshop) that they would all mark the same areas on the base map as economically valuable. Such consensus certainly influences what the data look like and complicates the subsequent spatial analysis but does not invalidate the results. On the contrary, it provides important insights into how politics and values are spatially connected. Mail or Internet-based surveys may limit, but not eliminate, these potential interaction effects as participants are more likely interacting with the map individually.

What Level of Data Accuracy Is Needed for the Project?

The workshop design can potentially prevent data anomalies (such as the label circling discussed earlier) and enhance standardization of mapping styles. Facilitators are able to clarify mapping instructions, assist in locating features, and answer participant questions. For example, some participants in the OP-HEM Project workshops exclaimed that they valued everything and wanted to circle the entire peninsula—informative in a qualitative sense but not useful for delineating specific spatial relationships or regional connections. A facilitator can explain this gently to the participant. Using mail surveys or Internet-based designs, on the other hand, may require eliminating a percentage of anomalous responses that do not achieve a desired level of data accuracy. In this case,

care must be taken to ensure an adequate sample size to account for removal of some features.

What Are the Mapping Skill Levels of the Targeted Population? Are They Familiar with the Study Area?

Care must be taken in assuming that all persons have the same level of skill in reading a map or the same familiarity with the study area. Though mailed mapping surveys or Internet-based strategies can reach a broad spectrum of a population, these methods of data collection can inadvertently eliminate those unfamiliar with an area or uncomfortable with mapping tools. In a workshop format, facilitators can address these issues more effectively.

If Using an Internet-Based Mapping Methodology, What Is the Extent of Internet Access and/or Computer Literacy?

Significant segments of the population (both rural and urban) still are without Internet service or lack computer literacy. However, discomfort with engaging in an online data collection tool is parallel to discomfort with participating in a public workshop; both may ultimately affect public participation. A combination of a facilitated workshop and mail/Internet survey may be appropriate in order to reach the desired constituency.

Challenge 4: Ascribed versus Assigned Landscape Values

LVM most often begins by creating a values typology that participants use to assign these values to different parts of the landscape. This predefined list aids in coding and aggregating the spatial data and, if used consistently, allows for cross-study comparisons. A landscape values typology specifically targets the subjective worth or importance that people attach to places, though these values may be associated with particular uses (e.g., recreation). However, it represents only one aspect of the much broader topic of land classification. Other classification schemes, for example, focus on land use, productive potential, biophysical characteristics, or ecosystem services (Apitz, 2013; Higgins et al., 1987; Rindfuss et al., 2004). Combination schemes also exist. Fagerholm et al. (2012), for example, construct a typology that links nonmaterial, cultural values with the material products that the landscape provides for the participant.

The OP-HEM Project used a popular values classification system adapted from a forest values typology originally

developed by Rolston and Coufal (1991) and subsequently validated by Brown and Reed (2000) (see Table 1). Participants were required to select a value for their chosen place from this list—an ascribed approach as opposed to an open-ended approach in which participants may assign their own words or descriptions to the valued place. Since a goal of the OP-HEM Project was to prepare the data for use in GIS and test the efficacy of various spatial analysis techniques, we used standardized values so that variables would be exhaustive and mutually exclusive for appropriate statistical analysis.

The use of a values typology provides some statistical assurances but is not without challenges. It relies on an assumption that participants ascribe the same meanings to the words used to delineate the landscape values. For example, in the OP-HEM Project, participants were often confused as to the difference between *subsistence* and *economics*—a distinction that was particularly meaningful on the Olympic Peninsula (e.g., separating an economic value associated with logging from the subsistence value of firewood collection). When using a values typology in a workshop format, sufficient time should be allotted to explain the value classes and answer any questions. (Note that there is an unavoidable assumption of understanding when applying a values typology in a mail or Internet mapping survey.) Collecting additional qualitative data (e.g., asking participants to describe *why* they value a particular place) can also be used by the researcher to assess the reliability of the value that the participant chose for a particular place.

Using an open-ended, or assigned, format for values has its own challenges. While it allows participants to choose their own words to describe what they value, the resulting descriptions must be interpreted and categorized by the researchers to create a manageable set of value classes for aggregation and further spatial analysis. (For example, where are the places people value highly for aesthetic value, regardless of whether they described the place as beautiful, pretty, stunning, gorgeous?) Additional challenges arise when interpreting word choices that can have different meanings. (For example, did a participant mean “wilderness” in an aesthetic sense or perhaps the word referred to its value as wildlife habitat?) Narrative analysis tools are available for creating mappable categories. These tools find and organize high-frequency and related words, but require that all the descriptions from all participants be combined for the analysis. This is problematic when working in a mapping environment because the description or word becomes disassociated from its corresponding spatial feature (or record) in the GIS database. Once the value

classes have been determined, it is extremely difficult to reassign the new class labels to the appropriate spatial features in order to map the results.

Challenge 5: Mapping Formats and Features

Points, Lines, and Polygons

Dot-density values mapping—providing participants with sticker dots to locate features on a base map—is a common methodology employed in LVM (Alessa, Kliskey, and Brown, 2008; Beverly et al., 2008). Mapping with dots is easy for participants to understand and simple to process and analyze. The aggregated points provide a density map of various landscape values. The OP-HEM Project, however, opted for an approach that allowed participants to draw points, lines, or polygons on the base map. Using multiple geometries provides both advantages and challenges.

Not all valued places can be adequately mapped by using a point, particularly at the regional scale. For example, the Olympic Peninsula contains several large wilderness areas highly valued by residents. Requiring participants to use only points would not capture the full spatial extent of the valued place. Using multiple geometries provides participants with more flexibility. On the Olympic Peninsula, points enabled participants to locate specific places, such as a favorite beach. Linear features were often used to identify reaches of streams representing multiple fishing spots. Polygons were employed by participants in sizes ranging from a small circle, such as a mountain peak, to a polygon encompassing the entire Olympic National Park.

The use of multiple geometries, however, introduces more complexity in participant mapping. For the mapper, the option of using points, lines, or areas to identify valued places requires a higher level of mapping skill and more time to complete. Drawing a polygon requires not only locating the feature on the map but also determining the desired areal extent and the exact boundaries of the feature (which may or may not be identified on the base map). The use of multiple geometries has the potential for increasing the spatial accuracy of the mapped features—where the drawn feature represents the intended spatial extent. However, as Figure 4 demonstrates, spatial accuracy may become inconsistent. Some mappers will simply draw generalized polygons, such as a large area of beachfront, whereas others may carefully outline the boundaries of a valued place, such as specific reaches of a stream.

This added complexity also affects data processing and interpretation. Particularly in the case of data integration with a GIS, processing multiple geometries is more time consuming than dots alone. Digitizing lines and polygons requires significant attention to detail. In addition, to be analyzed as a single data set in a GIS environment, the geometric type must be the same. In order to combine spatial layers of points, lines, and polygons for analysis purposes, small buffers must be placed around the points and lines to transform them into polygons.

A recent study by Brown and Pullar (2012) assesses the trade-offs between using points or polygons in participatory mapping. Their results note that the use of points to map landscape values results in a *lower* probability of misidentifying hotspots of values. Figure 4, for example, illustrates how the use of polygons may result in spurious hotspots where high-density areas are created simply by the inadvertent overlapping of individual polygons. In addition, when creating maps that show regions of high density or diversity, polygons also tend to be weighted more heavily simply by their larger areal extent than are points or lines. However, Brown and Pullar's results show that dot-density mapping requires a much larger number of participants in order to aggregate enough point features for identifying areas of significance (or hotspots) with a high degree of confidence: a minimum of 350 participants using dots only as opposed to about 25 when using polygons.

Mapping Idiosyncrasies

The use of multiple geometries can also highlight various mapping idiosyncrasies. Some participants may be detail oriented and proficient in fine-motor skills or they may simply like to draw small things. Or, a participant might have an expansive personality—someone who sees the big picture or likes to make sweeping generalizations. These idiosyncrasies may affect how the features are drawn on the base map, resulting in a preponderance of small detailed polygons or, conversely, large generalized areas. The extent of these tendencies is difficult to identify within the data set, much less quantify (and is a set of research questions in its own right).

In the case of workshops where multiple participants are drawing on the same base map, there might also be a *table effect*. If one person at the table first uses points to map valued places, other persons at the table may choose the same strategy. Or, if one person uses large generalized polygons to delineate valued places, others at the table may choose this strategy as well, despite their particular mapping preference.

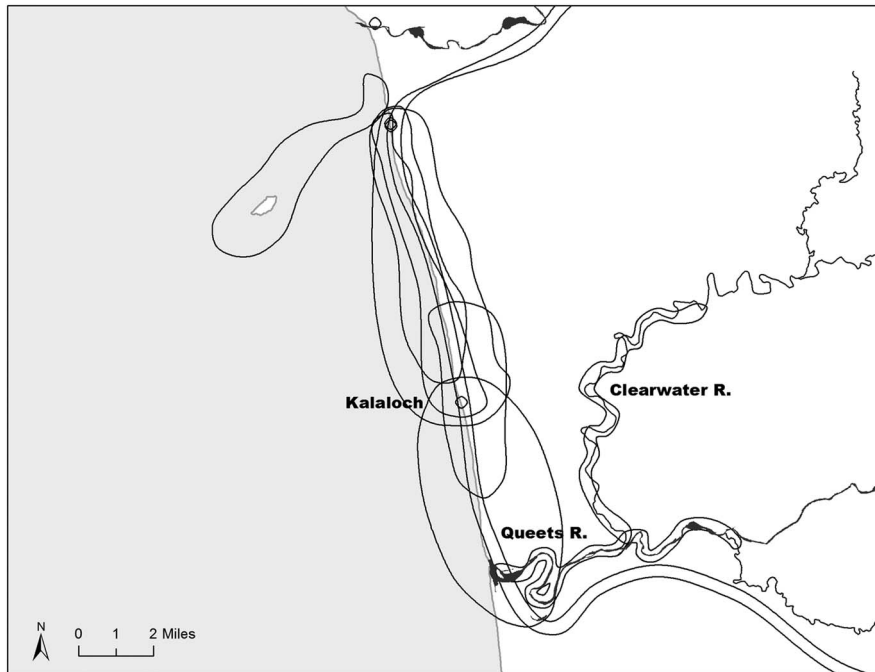


Figure 4. Digitized output from the Olympic Peninsula Human Ecology Mapping Project landscape values data set representing aesthetic values on the western beaches of the peninsula. The figure illustrates different mapping styles—mappers who drew generalized polygons covering the oceanfront, as well as those who indicated specific reaches of rivers (lines) or particular beaches (points). The figure also shows the potential confounding effects of overlapping polygons, particularly in the Kalaloch area, and illustrates how large polygons have a tendency to be overemphasized in relation to the point and line features by virtue of their large aerial extent.

Though little can be done to limit these mapping idiosyncrasies, various spatial statistical analyses can be conducted on the features mapped per table (if using a digital or GIS-based mapping strategy) to determine whether there is a significant difference in the mean shape or size variation among tables. To prepare for this type of analysis, the unique IDs assigned to each drawn feature during the digitizing phase must contain information that allows for sorting and aggregating the feature database by workshop and a specific table. [See McLain et al. (2013a), Appendix B, for a description of a feature coding system.]

Use of Landscape Values Data

Once the data are collected, aggregated, and interpreted, how the final analysis is used depends on the particular goals of the project. Though space does not permit a comprehensive discussion of the appropriate (or inappropriate) use of the data, a key element worth mentioning is the distinction between quantitative and qualitative spatial data. If a quantitative analysis is required, data collection should employ a digital mapping protocol to leverage GIS spatial analysis tools and focus on standardization of value classes to assist in generalization of the

results. Fagerholm et al. (2012) provide an excellent example of what can be achieved with quantitative spatial analysis using values data. Qualitative data are best emphasized by focusing on participant composition and skills in using a facilitation method (workshop), key informant mapping activities, or a one-on-one mapping protocol. These methods collect a rich repository of descriptive text for narrative analysis. Raymond et al. (2009) provide an example of how qualitative values data were used effectively to consolidate resident values and inform a planning process. Mixed methods should employ digital technology for the quantitative analysis and also include tools to collect additional descriptive data easily attached to the spatial feature for qualitative analysis.

Conclusion

LVM provides important insights into the connections people have with their environment. The strategies employed in LVM are diverse. There is no one best way or convenient checklist to determine which strategy should be employed under what circumstance. Understanding and working through the common issues and challenges in

LVM that have been described here will assist land managers and researchers in designing a LVM project that effectively balances their project's goals, time and budgetary constraints, and personnel resources in a way that gathers robust spatial sociocultural data and ensures the most inclusive participation while avoiding confounding effects.

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