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Mapping heritage ecosystem services in ecological restoration areas: A case study from the East Cascades, Washington

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ABSTRACT

Systems-based land management frameworks such as ecosystem services can improve cultural resource management and outdoor recreation in natural areas. We analyzed data from a participatory mapping survey of forest values from an ecological restoration area in the East Cascades, which provide conceptual and methodological tools that can be utilized in land management more widely. We also consulted archaeological, paleo-ecological, and traditional land use data to link heritage values with cultural landscapes. Heritage benefits mapped by respondents were associated with connections to landscapes, sites and resources, and with outdoor recreation. Respondents noted connections to historic vocational identities such as mining and logging, as well as sacred and spiritual activities associated with American Indian Tribes. These heritage connections and benefits were closely tied to natural resources, such as timber, mountains, watersheds, and forest products. In some cases, heritage and biophysical ecosystem services share synergies with regard to potential land management effects, while others would result in tensions or trade-offs for various beneficiaries. Integrated resource management provides a more holistic and informed view of land values that move beyond cultural and biophysical dichotomies, expanding the potential for managing outdoor recreation and heritage.

Management implications

Cultural landscapes, resources, and heritage are intrinsically linked with natural resources, but are rarely considered together when developing land management strategies. Human ecology mapping is an effective tool for spatially representing and recording heritage-related landscape values, and can be incorporated into traditional evaluations of biophysical ecosystem services and other land management plans, especially those tied to outdoor recreation. This study provides managers with a blueprint for measuring the values, experiences, and benefits of heritage resources and less tangible cultural ecosystem services, and how those services could be positively or negatively affected through land management decisions such as ecological restoration projects, which are becoming increasingly commonplace throughout the globe.

1. Introduction

Cultural heritage is a defining feature of how humans connect to the outdoors and make meaning out of the natural world. Despite this, natural places are often thought of as separate or disconnected from human history and influence (Harrison, 2015), particularly in the case of remote wildernesses that often constitute large portions of public lands and protected areas (Landres et al., 2000; Roenke & Lacy, 1998). In this study, we consider heritage in land management contexts as the traditional and multigenerational connections among people, places,

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landscapes, events, histories, and nature. Recent land management and conservation concepts, such as socio-ecological systems (McGinnis & Ostrom, 2014; Ostrom, 2009) and ecosystem services (Millennium Ecosystem Assessment, 2005) have sought to reintegrate natural and cultural resource management. Reintegration has focused on human dimensions of land systems, including sociocultural values, physical, environmental, and economic benefits, as well as synergies or tensions among resource benefits affected by various land management practices. However, methods of integrating cultural heritage within these new management models remain underdeveloped (Chan et al., 2012; Hølleland, Skrede, & Holmgaard, 2017).

The general omission of heritage from systems-based land management in the United States is curious, since many agencies and protected areas have staffs of archaeologists, historic preservationists, Tribal relations managers, and other heritage professionals. Due to the ways in which resource management policies are designed, however; heritage professionals are often relegated to regulatory compliance based on historic preservation laws to determine potential effects of land-disturbing activities on cultural properties. While this regulatory compliance framework is largely effective for site-based cultural resource preservation, it does not adequately account for understanding and managing for the benefits, connections, and values that communities place on heritage-related aspects of landscapes.

Human ecology mapping, a subset of participatory mapping focused on human-environment relationships drawing from sociological, anthropological, and ecological fields, is a tool that can help in measuring heritage-related landscape values. Human ecology mapping involves stakeholder participation through the identification of important places linked to values, experiences, and benefits, and provides a way to socio-spatially represent various human-landscape connections (Brown et al., 2014; Brown & Fagerholm, 2015; McLain et al., 2013). Human ecology mapping provides a means to link heritage values into wider land management systems. In this study, we utilize data from a participatory mapping survey to analyze cultural heritage activities, benefits, and values associated with an 80,000-acre checkerboarded landscape in central Washington slated for ecological restoration by a collaborative discussed below. The survey revealed a rich variety of heritage values, connections, and activities associated with the area that could be positively or negatively impacted by restoration activities. Our analysis focuses on what these heritage connections are and how they relate to other aspects of the cultural and biophysical environment. The goal of this paper is to provide evidence for the utility and overall potential of cultural heritage to improve systems-based land management planning and practices, and to explore the application of human ecology mapping and ecosystem services concepts to measure and manage for cultural heritage values.

1.1. Cultural heritage, ecosystem services, and human ecology mapping

At the turn of the new millennium, scientists and policymakers recognized a critical need to transform land management practices in the face of population increases, ecological degradation, and other anthropogenic impacts to the environment. Part of these efforts involved the founding of the Millennium Ecosystem Assessment (MA, 2005), an international consortium organized by the United Nations which popularized the ecosystem services framework of land management. Since the establishment of the MA, researchers and policymakers have worked to refine the ecosystem services concept and adapt it as a tool to address a variety of land management issues.

Ecosystem services frameworks rely on an integrated systems approach to measure the collective cultural, biophysical, and economic benefits a landscape provides, who the beneficiaries of those services are, and how management decisions positively or negatively impact them. Ecosystem services are grouped into four categories: provisioning, such as the production of food and water; regulating, such as the control of climate and disease; supporting, such as nutrient cycles and oxygen production; and cultural, such as heritage, spiritual, and recreational benefits (Fig. 1). Here, we consider cultural ecosystem services (CES) as the co-produced and mutually embedded feedbacks of human interactions with ecosystems and landscapes, in line with recent theorizations of the CES concept (e.g., Chan et al., 2012; Daniel et al., 2012; Diaz et al., 2015; Fish et al., 2016; Nassl & Löffler, 2015).

Because of their less tangible nature, CES have lagged behind biophysical services in the application of the ecosystem services concept (Chan et al., 2012). The relationship between cultural heritage and ecosystem services is even less developed. Holleland et al. (2017) conducted a literature review of ecosystem services-focused articles mentioning cultural heritage, finding only six articles within the scope of their study that were fully dedicated to the topic. Although CES continue to be discussed and new analyses tested, there is still not a common protocol or understanding of how cultural heritage fits into the CES and broader ecosystem services framework.

The limited cultural heritage and ecosystem services development conducted to date has taken place primarily in northern European countries, where cultural and natural resource management are already more integrated at an operational level. These studies range from those which are specific to a single type of resource context, such as wetlands, (Durham et al., 2012), to studies that develop tools to be applied in various CES contexts (e.g., Riksantikvaren, 2009; Tengberg et al., 2012).

A Norwegian task group developed the DIVE analysis–Describe, Interpret, Valuate and Enable–which is a phased analytical process used to measure cultural ecosystem services with an emphasis on heritage (Riksantikvaren, 2009). The DIVE technique, as practiced by Riksantikvaren (2009), employs time matrices, historical photographs and documents, semi-structured interviews, and inventories of cultural resources to analyze heritage values associated with historic features on the landscape in order to make planning suggestions based on those values. Kaltenborn et al. (2017) conducted a similar analysis of a fishing village in Norway that involved site visits, interviews with locals and tourists, group workshops, and participatory mapping in order to discover what the community valued as “the good life”, operationalized in terms of ecosystem services. Our study utilizes a similar approach by considering local heritage values, benefits, and activities.

Tengberg et al. (2012) analyzed the cultural heritage values associated with a maritime-agricultural landscape in rural Sweden through time-scale matrices of land changes, and utilized these matrices as a starting point for stakeholder engagement about cultural heritage. The decline of agricultural and fishing industries led to increased housing development in these areas, adversely affecting their historic character. Time-scale matrices and stakeholder interviews were able to demonstrate the heritage values that local communities still ascribed to these places, and how managing for their preservation would result in increased cultural as well as biophysical ecosystem services. They advocate for participatory approaches which consider heritage at an environmental and landscape scale as a way to bridge the goals of the MA and those of the World Heritage Conventions (UNESCO 1972) which often consider heritage conservation separately.

Ecosystem services frameworks have also been applied to more specific resource management concerns such as carbon off-gassing at the Star Carr archaeological site in England (Durham et al., 2012). Organic artifacts at the site have been decaying and releasing greenhouse gases since they were first uncovered when peatland was being reclaimed for farmland in the 1940s. The authors use a synergistic approach to support why the preservation and re-establishment of peatlands is necessary within an ecosystem as a whole in addition to how it could preserve an archaeological site. They conclude that by restoring the land back to its original character as a peatland, not only would a farmer be able to claim carbon credits through carbon capture, but the preservation and re-establishment of peatlands would help minimize global warming, improve water quality, and minimize flood risk.

The ecosystem services concept has been criticized as being anthropocentric, with the potential side effects of commodifying or

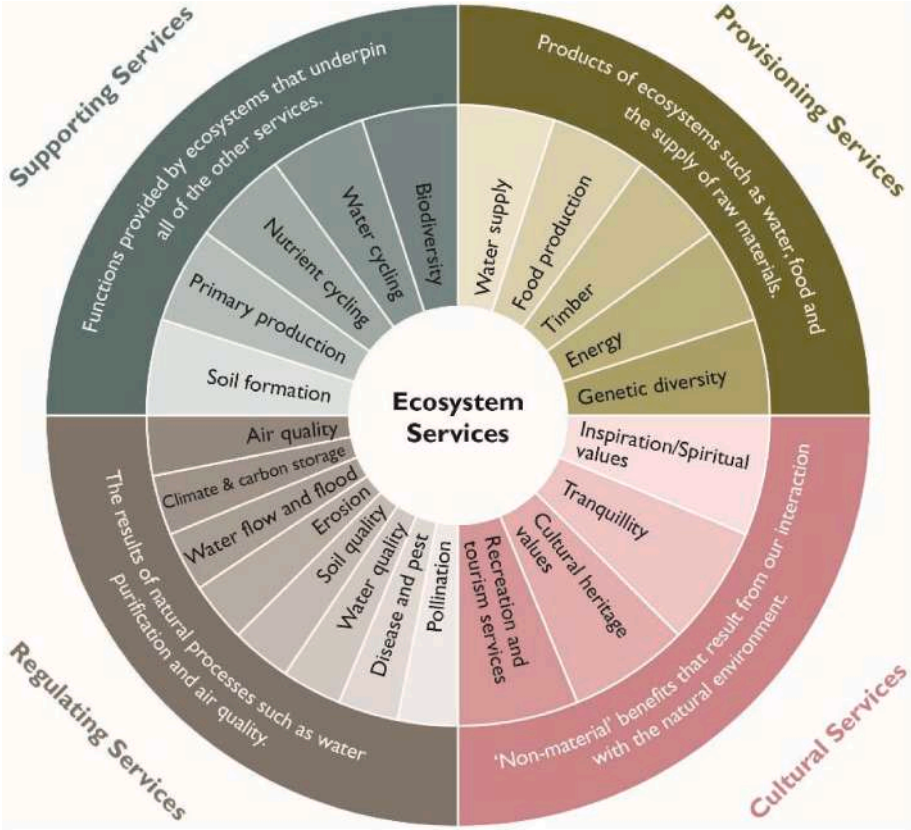

Fig. 1. Schematic displaying the four categories of ecosystem services. Courtesy of South Downs National Park Authority (2013).

appropriating nature (e.g., Fairhead et al., 2012; Gómez-Baggethun & Ruiz-Pérez, 2011) but has also been successful in gaining widespread support in political and policymaking spheres (Chaudhary et al., 2015). In the case of the United States Forest Service, ecosystem services analyses are now required as part of forest management planning (USDA FS 2012). This project is part of the agency's research efforts investigating various methods of integrating ecosystem services into Forest Service operations, which are moving from a management focus on forest acreage treated toward outcomes, impacts, and benefits of various management actions (See Deal et al., 2014; 2017).

Human ecology mapping is a powerful tool that allows stakeholders to state positions and negotiate interests associated with policymaking and political debates (McLain et al., 2017). The technique provides powerful qualitative, quantitative, spatial and social articulations that reify the experiential value-laden bonds between people and place. The spatial analysis can be analyzed to indicate density and popularity for given sections of trail or routes or a bound area. The demarcated area and the survey questions describe zones of personal significance. It also can provide insight into the varying perceptions of geographic boundaries for toponyms or names that are used in a place. When all respondents' results are aggregated, a multi-dimensional spatial and temporal analysis can be achieved revealing how people are valuing, using, coinciding, or conflicting in the landscape through both space and time.

Human ecology mapping, while widely practiced in broader studies of human connections to the outdoors, has been less developed in archaeological studies. One notable exception is a study by Barlindhaug (2012), which analyzed archaeological sites associated with heritage and lived experiences of the Sami in arctic Norway. Respondents depicted on topographic maps the locations of resources such as building locations, routes used during different seasons, berry picking areas, fishing lakes, and similar cultural resources. An archaeological survey of the area was subsequently conducted in order to comparatively analyze the archaeological and human ecology mapping contexts. The goal was to gain insight on how local community knowledge could be used to identify archaeological sites during the survey, and also to provide insight into the land use and heritage value that a landscape retains, including incorporation of that information into systems-based land management. Our study takes a similar approach by comparing archaeological data with responses from the human ecology mapping survey.

It should be noted that mapping cultural spaces, especially those imbued with sacred qualities, creates some dilemmas for participation because of locational confidentiality, and the fact that for many indigenous groups, entire landscapes are interwoven with significance, rather than particular locations having distinct importance over others (Carmichael et al., 2013; Milholland, 2010). As such, we implement a human ecology mapping approach which does not solely focus on site-specific importance, but also incorporates landscape-scale connections and narrative, non-spatial elements of heritage values through open-ended questions.

1.2. Collaborative forest landscape restoration and the East Cascades

Alongside the adoption of ecosystem services, the Forest Service has also undertaken significant efforts to conduct landscape-scale ecological restoration across jurisdictions driven by collaborative planning and management (See Schultz et al., 2012, 2014). These projects are known as collaborative forest landscape restoration projects, or CFLRP's, authorized by the 2009 Forest Landscape Restoration Act, and recently re-authorized by the Agricultural Improvement Act of 2018.

In the east Cascades of Washington, the Tapash Sustainable Forest Collaborative is overseeing CFLRP's focused on combating wildfire and restoring healthy forest and watershed ecosystems that have been degraded through wildfire suppression, deforestation, floodplain and riparian modifications, and other anthropogenic impacts (Haugo et al.,

2016). "Tapash" is composed of the Forest Service, the Yakama Nation, the Nature Conservancy, Washington State Department of Natural Resources, and Washington Department of Fish and Wildlife. Other non-governmental partner groups, such as the Mountains to Sound Greenway Trust and Washington Trails Association have also taken part in the collaborative's restoration efforts involving outdoor recreation.

To satisfy legal requirements of CFLRP's, projects are required to conduct social science research to ensure that they are socially and economically viable, and to provide a format for the public to bring forth management concerns. In this case, participatory mapping was utilized to evaluate stakeholder values, activities, and benefits associated with the Manastash-Taneum ecological restoration area. Manastash-Taneum

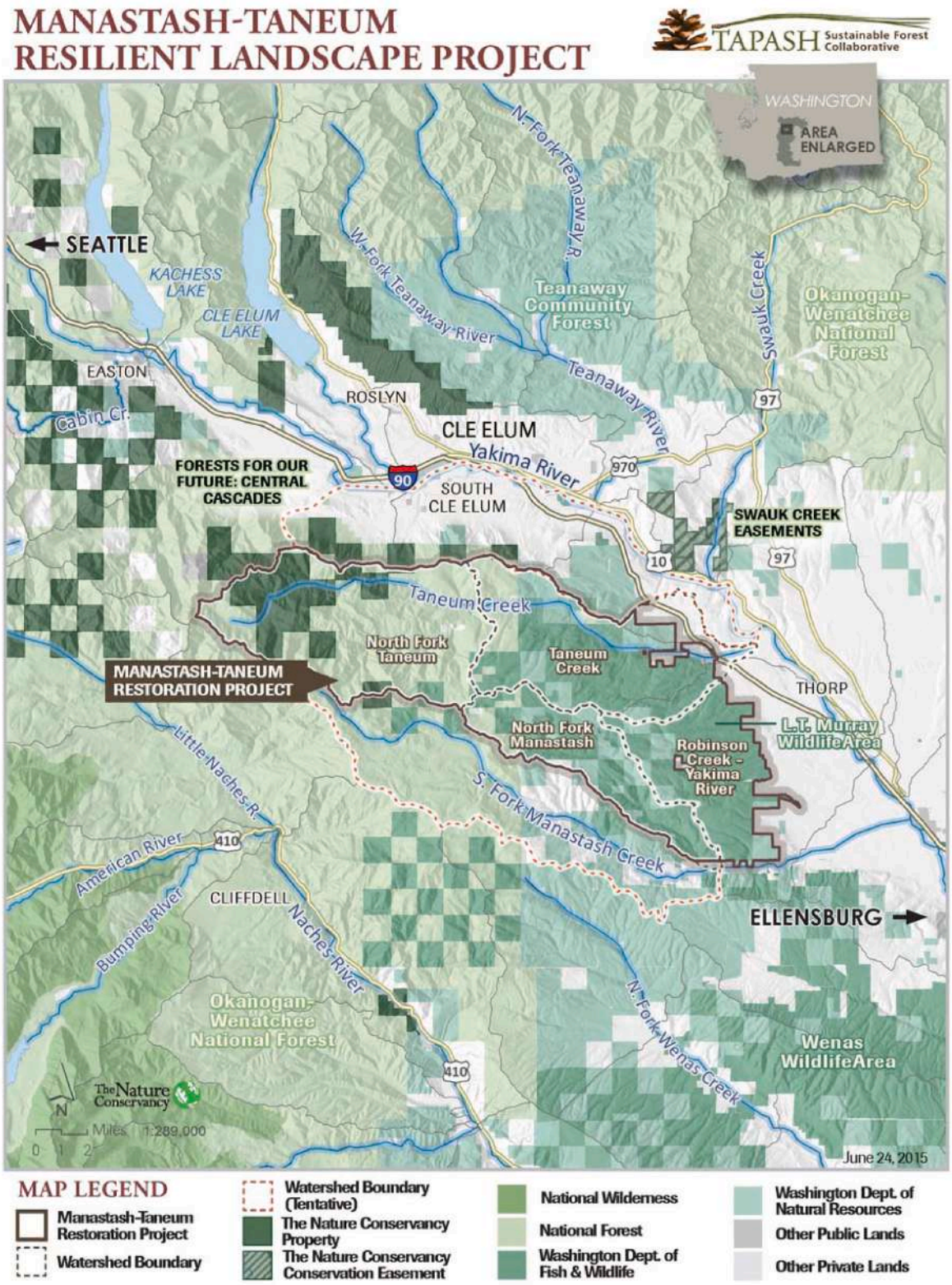

Fig. 2. General overview map of the Manastash-Taneum restoration area, East Cascades.

encompasses approximately 80,000 acres of forested mountains, ridges, streams and foothills along the eastern margins of the Cascade mountain range, and the western margins of the Yakima river basin (Fig. 2).

1.3. Paleoecology and land use history in the East Cascades

Paleoecology and land use history are integral to the understanding of contemporary heritage and ecosystem services of the east Cascades. Both climatic and human drivers have shaped the postglacial paleoecology and fire history of the Manastash-Taneum restoration area (Agee, 1993; Cwynar, 1985; Prichard et al., 2009; Walsh et al., 2015). Throughout the Holocene, fire played an active role in shaping millennial-scale forest composition. Warm, dry summers during the early Holocene (~11,000–8000 years ago) perpetuated frequent fires, favoring fire-dependent, pine-dominated landscapes (Prichard et al., 2009; Walsh et al., 2017). Cooler conditions during the middle Holocene (~8000–4500 years ago) saw the introduction of mixed-conifer stands and a reduction in high-intensity fire (Prichard et al., 2009). Pre-contact land use intensified during this period and regional charcoal studies suggest that low-intensity fires were frequently used by native peoples to encourage the growth of culturally important plant species, such as huckleberry, blueberry, and beargrass (Hummel et al., 2012; Walsh et al., 2017). This trend in fire activity continued in Central Washington until fire suppression efforts began during the early 20th century. A dendrochronological study of historical fire frequency near the Manastash-Taneum restoration area found that pre-contact mean fire return intervals ranged between 6 and 8 years, while fire suppression mean fire return intervals ranged between 38 and 60 years, with some stands not having a recorded fire since the early 20th century (Everett et al., 2000). As such, land management practices such as fire suppression significantly altered cultural landscapes of the area.

A vast region of the Cascades in central Washington is included in the ceded territory of the constituent bands and tribes of the Yakama Nation as recognized in the Treaty of 1855 (Schuster, 1998). The Kittitas Band occupied much of the upper Yakima River basin. Kittitas families were closely interrelated with the Wenatchi (Wenatchee, Wenatshapam) with whom they shared fisheries and settlements (Ray, 1936; Schuster, 1998). Trade, intermarriage, and co-utilization of resources grew ties with groups north and south on both sides of the Cascades (Anastasio, 1972; Schuster, 1998). The earliest exploration and occupation of the Cascade corridor began at least 10,000 years ago when mobile family bands of foragers/collectors harvested a wide range of resources (Chatters et al., 2012).

Late Fall was a prime time for hunting big game in their lower winter ranges. From spring through summer, roots and berries were available in uplands where big game also calved. Between mid-June and October fishing on the Columbia River and major tributaries concentrated groups and supported the storage and trade of foods. Variations of this logistic seasonal round, and fire management of forests, are evident as early as 5000 years ago (Hackenberger & Steinkraus, 2016). Within the past 2000 years some winter house settlements had grown to support extended families in the hundreds. By the mid-1700s the horse increased the range of seasonal rounds even as human populations were halved due to epidemic disease (Haines, 1938). By the 1800s large numbers of people (perhaps dispersed between family sites) met in the thousands in upland root meadows and/or productive fishing lakes and falls (Hollenbeck & Carter, 1986; Lally et al., 2014; Schuster, 1998).

Fur trading companies were prevalent in the area from the late 18th century until the outbreak of the war of 1812. By the mid-1800's military campaigns and treaty negotiations were part of objectives by Euro-Americans to claim the region (Hart, 2004). Gold mining was extensive, although of low yield. In the upper Kittitas County hard rock mining for gold and other metals began in earnest in the 1880s. Placer gold was difficult to recover from the upper river drainages although ethnic Chinese miners were able to make a living here until Euro-American conflict displaced their communities (Holstine, 1994).

High grade timber and coal, and rail lines in the 1890s reshaped the Pacific Northwest. The settlements of Cle Elum and Roslyn were company towns established by the Northern Pacific Railroad (NP). Timber and coal production were highly integrated and the railroads, private, state and federal logging and tree farming grew in complex and interrelated regional and national economic systems (Orvald & Hackenberger, 2008). USFS administrative infrastructure and fire suppression distinctly changed the forest landscapes at this time. These communities still identify heavily with their mining and logging pasts.

Between 1890 and 1930 General Land Office maps show significant amounts of Euro-American and some Native American and African American homesteading (and private inholdings) along with multiple wagon roads and trails reaching up tributaries and around lakes. The lakes and lower stretches of the Yakima River were first modified by irrigation at this time. Between 1906 and 1932 federal projects were designed and built to enhance water management on much larger scales (Dick, 1993). Early in these developments much private logging was sustained by the market for wood to make fruit boxes for the orchards of the lower Yakima Valley.

Today the region is changing as residents from the burgeoning Seattle metropolitan area, one of the fastest growing areas in the country, flock to the Cascades for outdoor recreation opportunities. The cumulative ecological and cultural effects on the Manastash Taneum and surrounding landscape changes over time are what restoration efforts in the region hope to address.

The US Forest Service is prioritizing restoration within ecosystems that have been degraded, damaged, or destroyed, based on past ecological conditions as a reference point, but goals are dynamic and consider various factors such as climate change predictions, fire, past land use, and socioeconomic conditions (USDA FS 2012). Restoration in the East Cascades will include restoring habitat connectivity and diversity in aquatic and riparian areas, and re-establishing more natural distributions of vegetation patches within heavily modified timber stands to increase wildlife habitat and biodiversity, and to combat catastrophic wildfire risk. All of these restoration activities have the potential to positively or negatively affect heritage values in various ways, and heritage can also inform how restoration activities can be improved, which we looked to explore in this study.

2. Methodology

Human ecology mapping was chosen as the principal method for analyzing human dimensions of landscape connections, uses, and concerns in the Manastash-Taneum area. This technique is well defined in participatory research (See McLain et al., 2013) and is referred to in this study as Human Ecology Mapping (HEM), but also referred to as Participatory Mapping (PM), Public Participation GIS (PPGIS), counter-mapping, social-mapping, or an array of other names from the fields of anthropology and geography. As a methodological tool, the map is a template to articulate individuals' unique environmental and cultural knowledge displayed spatially. Populations may become empowered when each person links their experience or perception in a place to a map; creating a collective map that defines and identifies a cognitive spatial and personal world imbued with meaning. While human ecology mapping has seen widespread use in other social science disciplines, it has not typically been used in conjunction with archaeological or heritage-based studies (See Barlindhaug, 2012; van Berkel & Verburg, 2014 for exceptions).

In 2017–2018, Central Washington University and the US Forest Service administered a combination of online and in-person HEM surveys over a 12-month period. In-person surveys were distributed at local events such as farmer's markets and county fairs, campgrounds, and trailheads, and the online survey was disseminated throughout social media tied to outdoor recreation and the local and Seattle greater metropolitan areas. The goal was to reach as wide of a user base as possible. Participants were provided with copies of maps displaying the

Manastash-Taneum area, including landscape features, roads, trails, campgrounds, and other landmarks. Each person could map up to three locations by drawing the perimeter of an area, as well as roads or trail routes associated with places that are important to them. Each participant was assigned a unique ID number after agreeing to participate in the study which linked to demographic data they provided along with the places they mapped and answers to a ten question survey.

The selection of participants for the survey was a random multistage sample (See Whittemore, 1997) of individuals that were familiar with the landscape, utilized the region for recreation, had a connection to the area, or had an interest in forest and rangelands management. Survey responses were aggregated and all given equal weight. This approach has the advantage of not biasing toward particular user groups, but can also under-represent values such as indigenous knowledge, where only designated knowledge keepers may be willing to share information.

Survey questions were predominantly close-ended and concentrated on the unique places that the informant identified, but also included opportunities for narrative responses about the significance and management concerns about those places. The following attributes were attached with each place identified.

- Why is the place important? (open-ended)
- Frequency of visitation, season, duration
- Group size
- Primary and associated benefits derived from this location
- Features of interest
- Activities undertaken
- Concerns or ideas about future management (open-ended)

In conjunction with the map, these questions were designed to elicit connections between the physical location that the respondent demarcated and their personal experience to the place. The process for an individual who is interacting with the actual location on the map, recording their cognitive experience or memories, not only provokes recollection of the place, but enhances their linkage to the place and the landscape.

We utilized polygon data to create 'hot spot' or heat maps displaying frequencies and spatial overlaps of mapped places based on various categories from the survey questions. The procedure uses each person's individual polygon, which creates a layer covering a defined geographic area. Each person's polygon may cover a geographically similar area to someone else or it may overlap in one part of the study area. For analysis, one of the closed-ended survey questions is queried to select all respondents that indicated a positive binary response. This will select all of the polygons that were mapped by the individuals with the positive response. Again, the close-ended questions identified benefits, landscape features, and activities carried out in a given place. Each polygon that has been selected for a positively coded response will cover a geographic area, polygons that overlap create stacked layers (Fig. 3). The locations that have the highest number of overlaps or "count" are the geographic locations that demonstrate the highest agreement amongst respondents of the queried response.

For example, as in graphic A below, respondent X delineates a boundary around a given site. Then, responds in their survey by selecting a checkbox that they like to camp as an activity in the area. The positive response is coded as a 1 in the online server-side geodatabase. Each respondent will then select another geographic boundary that may overlap with respondent X and may select that they also like to camp in the area (graphic B and C). The number of overlaps (graphic D) are then dissolved and counted for a new polygon that contains the count or frequency of overlaps (graphic E). This new feature layer then represents the locations with the most agreement amongst respondents that camping is favored in that specific area. Consequently, it identifies the concentration density or hotspot of users for whichever particular queried field.

The overlap feature data layer (that contains a count of the overlapping polygons) is then displayed using a classification of the numerical counts with 5 classes (Natural Breaks – Jenks) and a symbology of graduated color of continuous orange-reds, resembling a heat map. The outlines around the polygons are not displayed and therefore a final representation is a graduated color map showing the highest density in a darker red.

For the purposes of this study, we focused only on portions of responses related to cultural heritage. All responses and places which mentioned 'heritage, history, tradition' and 'connecting with culture' as benefits associated with a place were analyzed, along with features and activities where respondents selected 'cultural activities', 'sacred or cultural site', and 'visiting historic sites'. Open-ended responses which mentioned key words associated with cultural heritage were also analyzed. The results of the human ecology mapping survey were compared with an archaeological survey recently conducted in the area.

3. Results - Mapping heritage activities, benefits, and beneficiaries

The survey had 612 respondents (121 hardcopy + 491 online) who delineated 854 unique places in the Manastash-Taneum restoration area. A total of 127 (15%) entries identified cultural heritage as a benefit associated with those mapped places. Respondents were primarily from Kittitas County (41%) in the immediate surrounding area, and from King

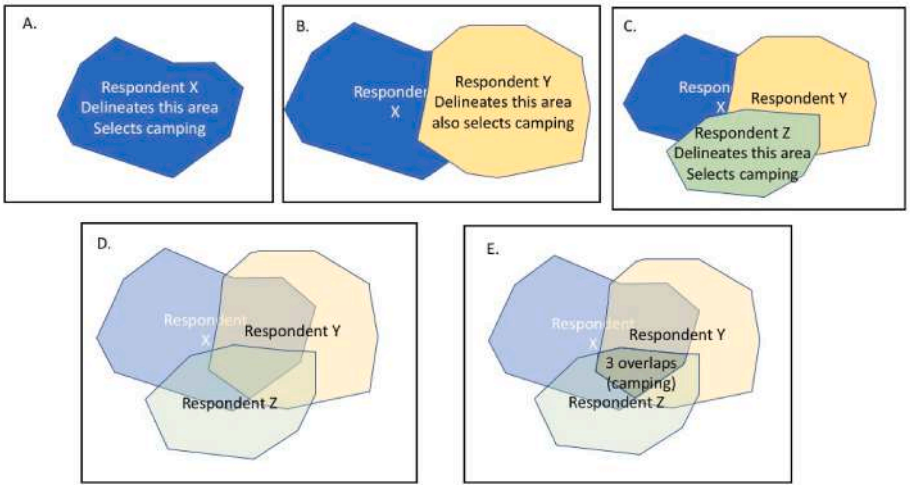

Fig. 3. Methodology for creating heat maps based on overlap of mapped areas and associated activities, features, and benefits.

County (19%) and Snohomish County (15%) in the greater Seattle Metropolitan area approximately 70 miles west. The respondents self-reported (meaning the survey question was open-ended) their gender as 68% males, 29% females, and 3% declining to answer. The self-reported ethnicity of individuals included people that self-identified as no-response, Asian, Black, English-Scottish, Mixed, Native American, Norwegian, Other, Pacific Islander, Scottish, Spanish-origin, and White. Of the above self-described groups, "White" comprised 83% of the respondents, 11% of respondents declined to answer, and all other ethnic groups comprised less than 1% of respondents. Kittitas County is 92% white (US Census 2019), in line with the demographic profile of the survey results. Hispanics are under-represented based on the survey results compared with county demographic profiles, which ties into a wider trend of racial inequities in public lands access and usage across the nation (Flores et al., 2018).

In terms of frequency of visits, respondents primarily went to places associated with heritage several times per year and during all seasons. Group sizes for place visits averaged 5 people. Heritage benefits were associated with 24 activities, including active outdoor activities such as hiking and hunting, motorized uses such as driving along roads and off-road motorcycling, and natural and cultural uses including wildlife viewing, forest gathering, cultural activities, and visiting historic sites (Table 1).

Places associated with heritage benefits included trails, campgrounds, mountains, springs, canyons, and other natural and cultural features. Of note, heritage benefits were most often associated with activities and places tied to outdoor recreation more broadly, and heritage was identified as one of many other benefits including fresh air, freedom, connecting with nature, and socializing. Respondents also stressed the multigenerational and traditional importance of these places and activities in open-ended responses about why the place is important to them (Table 2). As the responses from Tables 2 and 3 show, heritage benefits were tied to use values as well as non-use values, where respondents noted the importance of resource protection, and the knowledge that traditionally important places will be preserved.

Visiting historic sites was selected a total of 58 times as an activity associated with mapped places (Table 3). Hot spots for visiting historic sites coalesce around two major campground areas, the Taneum and Manastash campgrounds, but the activity covers the entirety of the area across various land jurisdictions (Fig. 4). In the northern hot spot area around Icewater Creek and the Taneum Campground, respondents noted attachments to the historic logging camps and associated features. A recent archaeological survey associated with the restoration effort examined over 3000 acres within the Manastash-Taneum restoration area, focusing on trails, riparian zones, and other recreational areas most likely to be impacted by planned restoration efforts. A number of

Table 1
Activities associated with heritage benefits.

	Activities Associated with Heritage Benefits	Count
Active Outdoor	Hiking	92
	Hunting	58
	Snow-mobile	41
	Fishing	35
	Mountain biking	30
	Skiing	24
	Swimming	22
	Target shooting	22
	Climbing	16
	Horseback riding	12
	Orienteering	9
	Canoeing	3
Motorized	Driving	78
	Motorcycle	67
	4 × 4	50
	ATV	21
Natural	Wildlife viewing	69
	Nature Photography	47
	Outdoor education	37
	Star-gazing	35
	Nature study	28
Cultural	Forest gathering	72
	Visiting historic sites	58
	Cultural activities	21

Table 2
Open-ended responses about why places associated with cultural heritage are important.

Family; Tradition	'Been hunting and camping and riding ATVs and dirtbikes and snowmobiles in the area for 40 years!'
	'My family has a long history of ""living off of the land"" in this area.'
	'Its been my family's fishing and native plant study area for 5 generations. I continue to hike, camp and study plants as do at least three of my cousins.'
	'Grandparents and one parent lived in the Taneum area logging camp working for Cascade Lumber during the locomotive logging days in the area - special place for that reason.'
	'I've been riding here since I was a kid with my dad, and have kept the tradition for the last 20 years and on to the next generation.'
	'Family enjoyment for snowmobiles. Historically used this area - family getting back into it now.'
	'My family camped at the Tamarack Springs Campground for years. The campground was closed and obliterated many years ago. It would be great if the campground were rebuilt.'
	'Been recreating in this area for 40 years. Family time that will be remembered forever. Motorcycles and off road recreation is something we value as a family tradition. These areas are shrinking at an alarming rate.'
Heritage; History	'I'd like to see you (us!) keep the heritage culture - like the grave of the White Woman.'
	'The old wagon trail used to come through here, 20 years or better. I still like to visit the campground & do short hikes.'
Sacred; Spiritual	'The entire area is an incredibly important native landscape with numerous resources and sacred places that need to be protected.'
	'Extremely important cultural and sacred sites (most unknown to land managing agencies) … Multiple tribes have used these resources and landscapes for thousands of years.'

Table 3
Primary locations discussed with regard to historic sites and cultural heritage.

Location Name	Activities	Resource	Management Concern/ Comments
Manastash and Taneum Campgrounds	Cultural activities; Motorized recreation; Camping; Visiting historic sites	Logging and mining	- Too much motorized recreation - Worried motorized recreation will be lost - Worried it is not being maintained well enough by the USFS
Tamarack Springs	Cultural activities; Motorized recreation; Camping; Visiting historic sites	Grave of the white woman; Wagon trail	- Maintain grave - Worried it will be taken away from the public - Too much motorized recreation - Not enough road maintenance
Quartz Mountain; Taneum Shelter	Cultural Connection; Camping; Sacred; Spiritual; Motorized Recreation	Lookout	- Keep trails open - Re-establish campground - Historical display at the lookout
Entire area	Cultural connections; Sacred; Spiritual; Visiting historic sites	Plants; Sacred sites	- Landscape-scale protection of these resources from development; environmental degradation; over-use

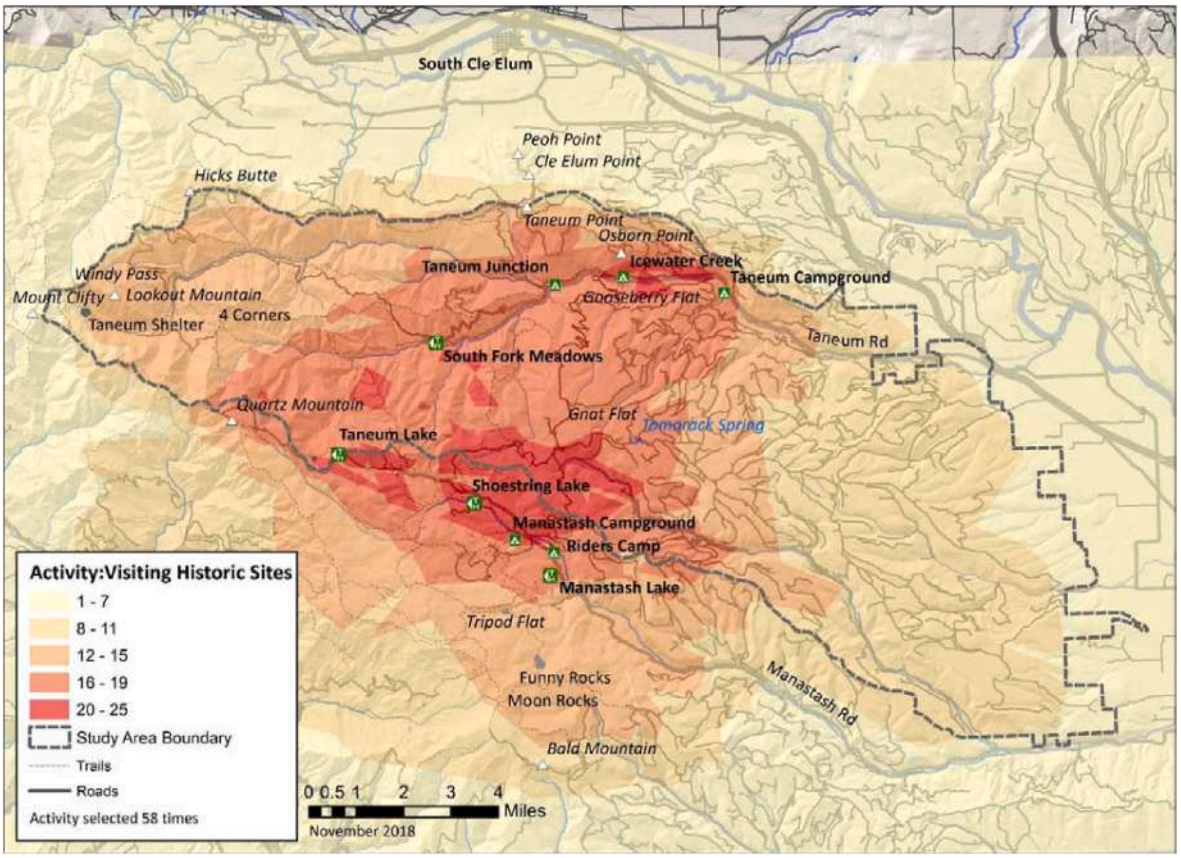

Fig. 4. Heat map of places associated with visiting historic sites.

features associated with logging during the early twentieth century were identified, including logging grades, trails, and bridges across streams.

Other historic features in the northern hot spot area include a Civilian Conservation Corps (CCC) portion of the Taneum campground which is still in use today (Fig. 5). Several historic grazing features are also located here. Historic features within the southern hot spot area around Manastash campground include remnants of historic mining and trapping, such as a demolished trapper cabin, historic mine adits, and shaking platforms (Fig. 6). Management concerns that respondents voiced for these areas primarily focused on motorized use both in support of and against, as well as overall maintenance of the area.

At Quartz Mountain and Taneum Shelter in the western area, respondents noted connections to a historic lookout tower located on top of the mountain (Fig. 7), which visitors valued for its history, as well as the challenge of getting there, and the solitude and scenic views that the higher elevation provides. Respondents recommended a historical display at the lookout, and to re-establish campgrounds.

The Tamarack Springs area located between the two campgrounds holds special significance in both the heritage and folklore of the region. A historic wagon trail, known as the Tamarack Trail passed through this area during the homesteading era, which respondents noted as a place

Fig. 5. Historic Civilian Conservation Corps (CCC) structure at Taneum Campground and Icewater Creek.

Fig. 6. Coal mining platform and associated structures.

Fig. 7. Historic photograph of the Quartz Mountain lookout tower.

connection. In particular, a historic grave known as the 'grave of the white woman' was mentioned in six responses as an important place to visit for heritage and history. According to ethnohistorical accounts (Sagoff, 2008), a family of pioneer migrants was traveling along the trail in 1870 when a pregnant woman fell from her horse. Both mother and newborn died and were buried at Tamarack Springs in a grave which was later marked with an inscribed stone reading 'Grave of the White Woman' (Fig. 8). Respondents noted that they would like to see better maintenance of the grave area, and re-establishment of a campground there.

Respondents also noted that the entire landscape has heritage-related significance beyond spatial factors, and some struggled to identify their connections by places or boundaries. This was particularly the case for American Indians and other respondents who noted the entire area holds importance for plant gathering, sacred spaces, and other cultural resources (See quotes from the Sacred; Spiritual section of Table 2). In addition, locations of plant resources, for instance, may be seasonal and ephemeral, making them difficult to map within a particular boundary.

4. Discussion. Heritage as a landscape-based ecosystem service

The human ecology mapping exercise conducted in the Manastash-Taneum region of the East Cascades revealed place-based as well as landscape-scale information relative to the recreational activities and

Fig. 8. Gravestone marked 'A White Woman's Grave' from Tamarack Springs.

overall heritage-based connections that stakeholders ascribe to the area. Visitors primarily came from the immediate surrounding regions of Kittitas County and the broader Seattle metropolitan area in small groups of family and friends. Heritage benefits they identified in relation to places mapped spanned 24 activity types (Table 1), underscoring how inter-connected heritage is to broader notions of nature, place, and outdoor recreation. Even visiting historic sites, which is often thought of as an activity separate from outdoor recreation, was part of a larger system of recreational experiences including hiking, motorized use, camping, and cultural activities. These activities were linked not only to heritage as an ecosystem service provided to users, but also with feelings of escape, freedom, emotional well-being, and overall connections to both nature and culture. Issues with access featured prominently in respondents' experiences and management concerns with heritage spaces and for outdoor recreation overall. While some users expressed that motorized usage and access were critical to their heritage-related recreational experiences, others wanted more restricted motorized use due to perceived dangers, resource degradation, and disruptions.

In terms of heritage ecosystem services seen in Manastash-Taneum and their relationship to other ecosystem services, several inferences can be made regarding potential effects from ecological restoration. First, watershed restoration and re-establishing habitat connectivity may result in negative impacts to resources identified near waterbodies, such as the logging, mining, and grazing features in areas that respondents noted and were identified through the archaeological survey. Due to their mundane nature, many of these features would not legally qualify for protections associated with more prominent archaeological sites, such as those eligible for the National Register of Historic Places. Rather, it is only through dialogue with stakeholders that connections to smaller scale or more landscape-based heritage resources can be identified and managed for.

Other restoration activities, such as forest thinning and prescribed burns, could have a positive impact on both biophysical and cultural ecosystem services. These restoration practices could increase accessibility and enhance viewscapes of heritage resources, while also improving overall forest health linking to supporting, provisioning, and regulating services. Forest thinning, for instance, could provide space for additional campgrounds and interpretive areas in places associated with cultural heritage, such as Quartz Mountain and Tamarack Springs which were mentioned numerous times by survey respondents. At the same time, both positive and negative effects on viewscapes should be considered.

As respondents to the survey noted, campgrounds were critical locations linked to history, family traditions, and senses of place, and people remember and continue to value locations of campgrounds that were removed in the past. Re-establishing native plant regimes could also have a positive impact for the natural environment through

increasing species diversity, as well as traditional cultural gathering practices. Traditionally important plant species of the Cascades, such as huckleberry (*Vaccinium* sp.), camas (*Camassia* sp.), bitterroot (*Lewisia rediviva*), and others thrive in a more open forest canopy (See Anzinger, 2002; Storm & Shebitz, 2006) with active fire regimes, reflected in the archaeological and paleo-ecological data for the region. These are land conditions which American Indians have managed for thousands of years (Stenos et al., 2006).

Heritage ecosystem services in Manastash-Taneum would benefit from increased awareness of heritage connections and places in the area, as well as sustainable long-term maintenance and preservation of heritage resources and landscapes. For instance, users noted connections to both the ancient and historical character of the region, including vocational identities associated with logging and mining, historical connections to the pioneer era, and deep spiritual connections to the indigenous past spanning millennia. Nearby towns have already begun to promote these traditional identities through tourism and community development initiatives. In the town of Roslyn, for instance, historic mining monuments as well as a mining nature trail which traverses through historic mining landmarks could be expanded into more remote outdoor recreation contexts.

Based on survey responses, most of the beneficiaries of heritage ecosystem services were people with direct familial, Tribal, cultural, or historic affiliations with the area. Because of the area's proximity to the Seattle metropolitan area, there is also potential to increase the number of heritage beneficiaries through educational and interpretive signage that can provide new arrivals and people from outside descendent communities with a sense of place, especially ethnic minorities who are under-represented in outdoor recreation use. In sum, restoration projects would be best served if conceptualized as both ecological and cultural restoration of landscapes, which recognize and manage for the deep attachments people have to the outdoors.

5. Conclusions

Cultural heritage can play an important role in improving landscape restoration, and ecosystem services are an effective conceptual framework for integrating cultural and natural resource management. As our study demonstrated, people ascribe special heritage values to rural outdoor spaces that impact outdoor recreation patterns. Rather than thinking of outdoor places as wildernesses devoid of human activity, people are strongly connected to the traditions, history, and cultural resources found in nature. Responses to our survey revealed that these connections are crucial to the outdoor recreation experience. Through human ecology mapping surveys, we were able to measure the collective activities, benefits, and values associated with heritage in the East Cascades. Respondents noted cultural heritage benefits as part of nearly every outdoor recreation activity, including motorized recreation, hunting, fishing, camping, and hiking, as well as more explicit heritage activities like visiting historic sites and traditional plant gathering.

As opposed to being separated, survey and mapping data revealed that heritage melds into the broader nature and outdoor recreation experience, and aligns with other ecosystem-derived benefits such as escape, exercise, fresh air, and overall wellbeing. In this case, connections to historic vocational identities and sacred indigenous practices were key heritage benefits provided by the Manastash-Taneum area, which have direct linkages with biophysical services. While some heritage benefits were place-specific, such as historic campgrounds and landmarks, many others are manifested at a broader landscape scale, and tie in to both use-based and non-use values.

In many cases, heritage and biophysical services have synergies and can be collectively improved through restoration projects if land managers are aware of those heritage connections. Indigenous and traditional knowledge, as well as archaeological data can also help to guide restoration management, as we illustrated with regard to traditional plants, forest management, and archaeological resources. There may also be trade-offs if ecological restoration practices erase historic characteristics of the landscape. Understanding trade-offs and synergies among cultural and biophysical ecosystem services and how they are affected by landscape restoration decisions is key to successful and sustainable resource management, and should continue to be explored through further research and case studies. Specifically, more research is needed on the impacts of various types of restoration activities on heritage values in different regional and cultural contexts.

In this study, we were able to link heritage benefits and values of outdoor recreation to archaeological, paleo-ecological, and land use data in ways that can advance systems-based land management, and help to move beyond regulatory compliance-centric cultural resource management. Human ecology mapping information supplemented with archaeological data and traditional land use provide empirical avenues for measuring cultural ecosystem services, and provide one potential solution to the ongoing issue of representing less tangible benefits that people receive from outdoor recreation and the natural environment. This case study hopefully encourages further interdisciplinary exploration of cultural ecosystem services, as landscape restoration initiatives continue to increase worldwide.

Declarations of competing interest

None.

CRediT authorship contribution statement

Matthew Helmer: Conceptualization, Writing - original draft, Project administration, Funding acquisition. **Jennifer Lipton:** Methodology, Supervision, Software, Formal analysis, Data curation, Resources, Visualization. **Grant Snitker:** Writing - original draft, Investigation, Formal analysis. **Steven Hackenberger:** Writing - original draft, Methodology, Supervision. **Mallory Triplett:** Writing - original draft, Investigation, Formal analysis. **Lee Cerveny:** Funding acquisition, Supervision, Resources.

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References

Agee, J. K. (1993). *Fire ecology of Pacific Northwest forests*. Washington D.C: Island Press.

Anastasio, A. (1972). The southern plateau: An ecological analysis of intergroup relations. *Northwest Anthropological Research Notes, 6*(2).

Anzinger, D. (2002). *Big huckleberry (Vaccinium membranaceum Dougl.) ecology and forest succession, Mt. Hood national forest and warm springs Indian reservation, Oregon*. M.Sc. Thesis. U. of Oregon.

Barlindhaug, S. (2012). Mapping complexity. Archaeological sites and historic land use extent in a Sami community in artic Norway. *Fennoscandia Archaeologica, 29*, 109–124.

Brown, G., & Fagerholm, N. (2015). Empirical PPGIS/PGIS mapping of ecosystem services: A review and evaluation. *Ecosyst. Ser., 13*, 119–133.

Brown, G., Weber, D., & De Bie, K. (2014). Assessing the value of public lands using public participation GIS (PPGIS) and social landscape metrics. *Applied Geography, 53*, 77–89.

Carmichael, D. L., Hubert, J., Reeves, B., & Schanche, A. (2013). *Sacred sites, sacred places*. Oxford: Routledge.
Chan, K. M. A., Satterfield, T., & Goldstein, J. (2012). Rethinking ecosystem services to better address and navigate cultural values. *Ecological Economics, 74*, 8–18. https://doi.org/10.1016/j.ecolecon.2011.11.011.
Chatters, J. C., Hackenberger, S., Prentiss, A. M., & Thomas, J.-L. (2012). The paleoindian to archaic transition in the Pacific Northwest. In *From the pleistocene to the holocene: human organization and cultural transformations in prehistoric North America, 17* p. 37).
Chaudhary, S., McGregor, A., Houston, D., & Chettri, N. (2015). The evolution of ecosystem services: A time series and discourse-centered analysis. *Environmental Science & Policy, 54*, 25–34.
Cwynar, L. C. (1985). Fire and forest history of the northern Cascade Range. *Ecology, 68*, 791–802.
Daniel, T. C., Muhar, A., Arnberger, A., Aznar, O., Boyd, J. W., Chan, K. M. A., … von der Dunk, A. (2012). Contributions of cultural services to the ecosystem services agenda. *Proceedings of the National Academy of Sciences, 109*, 8812–8819. https://doi.org/10.1073/pnas.1114773109.
Deal, R., Smith, N., & Gates, J. (2017). Ecosystem services to enhance sustainable forest management in the US: Moving from forest service national programmes to local projects in the Pacific Northwest. *Forestry: International Journal of Financial Research*, 1–8, 00.
Deal, R. L., Weidner, E., & Smith, N. (2014). Integrating ecosystem services into U.S. Forest service programs and operations. In *Federal resource management and ecosystem services guidebook. National ecosystem services partnership, duke university*.
Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N., … Zlatanova, D. (2015). The IPBES Conceptual Framework — connecting nature and people. *Current Opinion in Environmental Sustainability, 14*, 1–16. https://doi.org/10.1016/j.cosust.2014.11.002.
Dick, T. A. (1993). Yakima project. Bureau of reclamation. http://www.usbr.gov/projects/Project.jsp?proj_Name=Yakima+Project. (Accessed 31 October 2013).
Durham, B., van de Noort, R., Vandrup Martens, V., & Vorenhout, M. (2012). Organic loss in drained wetland monuments: Managing the carbon footprint. *Conservation and Management of Archaeological Sites, 14*(1-4), 85–98.
Everett, R. L., Schellhaas, R., Keenum, D., Spurbeck, D., & Ohlson, P. (2000). Fire history in the ponderosa pine/Douglas-fir forests on the east slope of the Washington Cascades. *Ecological Management, 129*, 207–225. https://doi.org/10.1016/S0378-1127(99)00168-1.
Fairhead, J., Leach, M., & Scoones, I. (2012). Green grabbing: A new appropriation of nature? *Journal of Peasant Studies, 39*(2), 237–261. https://doi.org/10.1080/03066150.2012.671770.
Fish, R., Church, A., & Winter, M. (2016). Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. *Ecosystem Services, 21*, 208–217. https://doi.org/10.1016/j.ecoser.2016.09.002.
Flores, D., Falco, G., Roberts, N. S., & Valenzuela, F. P., III (2018). Recreation equity: Is the forest service serving its diverse publics? *Journal of Forestry, 116*(3), 266–272.
Gómez-Baggethun, E., & Ruiz-Pérez, M. (2011). Economic valuation and the commodification of ecosystem services. *Progress in Physical Geography, 35*, 613–628.
Hackenberger, S., & Steinkraus, S. (2016). *Archaeological context for reservoirs in the cascade region of Washington state. Unpublished report prepared for the bureau of Reclamation Yakima, WA*.
Haines, F. (1938). The northward spread of horses among the plains Indians. *American Anthropologist, 40*, 429–437.
Harrison, R. (2015). Beyond "natural" and "cultural" heritage: Toward an ontological politics of heritage in the age of anthropocene. *Heritage and Society, 8*, 24–42. https://doi.org/10.1179/2159032X15Z.00000000036.
Hart, R. E. (2004). *Traditional cultural properties of the confederated tribes of the colville reservation associated with rocky reach dam. Cultural resource management report.* Chelan County, WA: Chelan County Public Utility. District No 1.
Haugo, R., Gaines, W., Begley, J., Robertson, J., Churchill, D., Dickinson, J., … Hessburg, P. (2016). Manastash-taneum resilient landscapes project: Landscape evaluations and prescriptions. http://www.tapash.org/okawen/wp-content/uploads/2016/09/ManastashTaneum_May2016v4.pdf. (Accessed 9 January 2019).
Hølleland, H., Skrede, J., & Holmgaard, S. (2017). Cultural heritage and ecosystem services: A literature review. *Conservation and Management of Archaeological Sites, 19*(3), 210–237.
Hollenbeck, J. L., & Carter, S. L. (1986). *A cultural resource overview: Prehistory and Ethnography, wenatchee national forest*. Olympia, WA: U.S. Department of Agriculture, Wenatchee National Forest. Copies available from Washington State Department of Archaeology and Historic Preservation.
Holstine, C. (1994). *An historical overview of the wenatchee national forest, Washington.* Cheney: Archaeological and Historical Services. Report No. 100-80.
Hummel, S., Foltz-Jordan, S., & Polasky. (2012). *Natural and cultural history of beargrass (xerophyllum tenax), Pacific Northwest research station general technical report 864, corvallis*.
Kaltenborn, B. P., Linnell, J. D. C., Baggethun, E. G., Lindhjem, H., Thomassen, J., & Chan, K. M. (2017). Ecosystem services and cultural values as building blocks for 'the good life'. A case study in the community of rost, lofoten islands, Norway. *Ecological Economics, 140*, 166–176.
Lally, J., Camuso, C., & Oliver, N. (2014). *Cultural resources investigation of the Yakima basin integrated plan: Keechelus lake kachess lake, Cle Elum lake*. Archaeological Report prepared for the Bureau of Reclamation by the Yakama Nation Cultural Resources Program.
Landres, P. B., Brunson, M., Merigliano, L., Sydoriak, C., & Morton, S. (2000). Naturalness and wilderness: The dilemma and irony of managing wilderness. In D. N. Cole, S. F. McCool, W. T. Borrie, & J. O'Loughlin (Eds.), *Wilderness science in a time of change* (Vol. 5). USDA Forest Service Rocky Mountain Research Station.
McGinnis, M., & Ostrom, E. (2014). Social-ecological system framework: Initial changes and continuing challenges. *Ecology and Society, 19*(2).
McLain, R., Cerveny, L., Biedenweg, K., & Banis, D. (2017). Values mapping and counter-mapping in contested landscapes: An olympic peninsula (USA) case study. *Human Ecology, 45*(5), 585–600.
McLain, R. J., Poe, M. R., Biedenweg, K., Cerveny, L., Besser, D., & Blahna, D. (2013). Making sense of human ecology mapping: An overview of approaches to integrating socio-spatial data into environmental planning. *Human Ecology, 41*, 651–655.
Milholland, S. (2010). In the eyes of the beholder: Understanding and resolving incompatible ideologies and languages in US environmental and cultural laws in relationship to Navajo sacred lands. *American Indian Culture & Research Journal, 34*(2), 103–124.
Millennium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis*. Washington DC: Island Press.
Nassl, M., & Löffler, J. (2015). Ecosystem services in coupled social–ecological systems: Closing the cycle of service provision and societal feedback. *Ambio, 44*(8), 737–749. https://doi.org/10.1007/s13280-015-0651-y.
Orvald, T. O., & Hackenberger, S. (2008). *Roslyn historic district No. 4 coal mine (45KT2784) industrial space cultural resource assessment, upper Kittitas county, Washington. Cultural resource management report on file department of archaeology and historic preservation, olympia, WA*.
Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science, 325*(5939), 419–422.
Prichard, S. J., Gedalof, Z., Oswald, W. W., & Peterson, D. L. (2009). Holocene fire and vegetation dynamics in a montane forest, North Cascade Range, Washington, USA. *Quaternary Research, 72*, 57–67. https://doi.org/10.1016/j.yqres.2009.03.008.
Ray, V. F. (1936). Native villages and groupings of the Columbia basin. *Pacific Northwest Quarterly, 27*(2), 54.
Riksantikvaren. (2009). *Urban heritage analysis. A handbook about DIVE*. Oslo: Riksantikvaren.
Roenke, K., & Lacy, D. (1998). Our wilderness heritage: A study of the compatibility of cultural and natural resource management. In H. G. Vogelsong, & comp (Eds.), *Proceedings of the 1997 Northeastern recreation research symposium; 1997 april 6-9; bolton landing, NY. Gen. Tech. Rep. NE-241* (Vol. 241). Radnor, PA: US Department of Agriculture, Forest Service, Northeastern Forest Experiment Stat.
Sagoff, M. (2008). On the economic value of ecosystem services. *Environmental Values, 17*, 239–257.
Schultz, C. A., Coelho, D. L., & Beam, R. D. (2014). Design and governance of multiparty monitoring under the USDA forest service's collaborative forest landscape restoration program. *Journal of Forestry, 112*(2), 198–206. https://doi.org/10.5849/jof.13-070.
Schultz, C. A., Jedd, T., & Beam, R. D. (2012). The collaborative forest landscape restoration program: A history and overview of the first projects. *Journal of Forestry, 110*(7), 381–391. https://doi.org/10.5849/jof.11-082.
Schuster, H. H. (1998). Yakima and neighboring groups. In *Handbook of the north American Indians. D.E. Walker*. Washington DC: Smithsonian Institution.
Senos, R., Lake, F. K., Turner, N., & Martinez, D. (2006). Traditional ecological knowledge and restoration practice. In D. Apostol, & M. Sinclair (Eds.), *Chapter 17.. Restoring the Pacific Northwest: The art and science of ecological restoration in cascadia* (pp. 393–426). Washington, DC: Island Press, 393–426.
South Downs National Park Authority. (2013). South Downs national Park partnership management plan: 2014-2019. https://www.southdowns.gov.uk/wp-content/uploads/2015/01/SDNP-Partnership-Management-Plan-2014-19.pdf. (Accessed 10 June 2019).
Storm, L., & Shebitz, D. (2006). Evaluating the purpose, extent, and ecological restoration applications of indigenous burning practices in southwestern Washington. *Ecological Restoration, 24*(4), 256–268.
Tengberg, A., Fredholm, S., Eliasson, I., Knez, I., Saltzman, K., & Wetterberg, O. (2012). Cultural ecosystem services provided by landscapes: Assessment of heritage values and identity. *Ecosyst. Ser., 2*, 12–26.
UNESCO United Nations Educational, Scientific, and Cultural Organisation. (1972). Convention concerning the protection of the world cultural and natural heritage. In *17th general conference of UNESCO. 17 october-21 november*. https://whc.unesco.org/archive/convention-en.pdf.
U.S. Census Bureau. (2019). Quick facts, Kittitas county. https://www.census.gov/quickfacts/fact/table/kittitascountywashington/BZA010217. (Accessed 24 January 2020).
U.S. Department of Agriculture, Forest Service [USDA FS]. (2012). *National forest system Land Management planning. 36 federal register §219 (15 may)*. Washington, DC.
van Berkel, D. B., & Verburg, P. H. (2014). Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. *Ecological indicators, 37*, 163–174.
Walsh, M. K., Lukens, M. L., McCutcheon, P. T., & Burtchard, G. C. (2017). Fire-climate-human interactions during the postglacial period at sunrise ridge, mount rainier national Park, Washington (USA). *Quaternary Science Reviews, 177*, 246–264. https://doi.org/10.1016/j.quascirev.2017.10.032.
Walsh, M. K., Marlon, J. R., Goring, S. J., Brown, K. J., & Gavin, D. G. (2015). *A regional perspective on Holocene fire–climate–human interactions in the Pacific Northwest of annals of the American association of geographers, 105* pp. 1135–1157). https://doi.org/10.1080/00045608.2015.1064457.
Whittemore, A. S. (1997). Multistage sampling designs and estimating equations. *Journal of the Royal Statistical Society: Series B, 59*, 589–602. https://doi.org/10.1111/1467-9868.00084.