UNESCO, mining heritage and the scalar sustainability of tourism geographies at industrial World Heritage Sites

Mark Alan Rhodes II and Kathryn Laura Hannum

Abstract

Purpose – *Industrial heritage works within a world of contradictions, contentions and scalar liminality. Archaeologists and historians focus upon oral histories and discourses of tangible and intangible memory and heritage while planners and economists see industrial World Heritage, in particular, as a marketing ploy to redevelop deindustrialized spaces. Within this liminality, we explore the potential for geographical perspectives to solder such contradictions into transdisciplinary heritage assessments and tourism contexts. How might the spatial tools of landscape and scalar analyses expose alternative and sustainable futures within broader patterns of industrial heritage management and consumption?*

Design/methodology/approach – *Using three comparative cases, interview and landscape methods and conducting discourse analysis within a spatial and scalar framework, we explore the increasing presence of industrial World Heritage.*

Findings – *We present both an institutional reflection upon the complexities of heritage discourse across complex spatial configurations and the intersectional historical, cultural, political, environmental and economic geographies that guide and emerge out of World Heritage Designations. Framed scalarly and spatially, we highlight common interpretation, tourism and heritage management styles and concerns found across industrial World Heritage. We point out trans-scalar considerations for future municipalities and regions looking to utilize their industrial landscapes and narratives.*

Originality/value – *We believe that more theoretical groundings in space and scale may lead to both the flexibility and the applicability needed to assess and, in turn, manage trans-scalar and trans-spatial complex heritage sites. These perspectives may be uniquely poised to assess the complex geographies of industrial, particularly mining, World Heritage Sites.*

Keywords *Scale, Mining, Sustainable tourism, World Heritage, Industrial heritage, Tourism geographies*

Paper type *Research paper*

Mark Alan Rhodes II and Kathryn Laura Hannum are both based at the Department of Social Sciences, Michigan Technological University, Houghton, Michigan, USA.

Received 27 October 2023
Revised 14 April 2024
Accepted 1 August 2024

Sustainable scales of industrial World Heritage tourism

At the intersection of World Heritage (WH) studies, industrial heritage management and sustainable tourism planning sits a core and continually debated question: should our post-industrial landscapes be conserved for their cultural significance or redeveloped for their economic potential? While some question how to best bring these two camps of discourse together to implement sustainable and community-generated tourism policy within industrial and/or World Heritage Sites (WHSs), these questions reflect similar arguments within heritage and policy studies. Scholars such as James and Winter (2017) or Lwoga (2018) do not presume to know what economic treatment is best for any given landscape or community nor what scale any development should take place at, if at all. It is from this later perspective which we approach our industrial WHSs. While they are indeed post-mining heritage sites and significant threads of industrial heritage work explore the possibilities of economic revitalization through the implementation of heritage and tourism structures, such simplistic notions of economic geography rarely result in

positive impacts across the communities implementing or having development implemented upon them. Scale, we argue, is a key missing element in such ongoing debates both within tourism and heritage studies, and not simply a top down vs bottom-up dichotomy but understanding scale as both socially constructed and fluid.

Across both ecological and cultural heritage conservation, scale often takes the form of an organizing unit or clearly defined policy distinction (Battisti and Fanelli, 2015; Li *et al.*, 2023). Certainly, when dealing with WHS, in particular, clear, hierarchical and inclusive management strategies are necessary to both determine community and regional goals and attempt to implement them (Olya *et al.*, 2018; Lwoga, 2018; Salazar, 2007; Odede *et al.*, 2022). While some work, such as Odede's *et al.* (2022, p. 40) exploration of community-based organizations in the management of Kit Mikayi Shrine in Kenya speaks to the challenges of simply drawing from "community-based" management strategies within multi-scalar governance contexts (c.f. Olya *et al.*, 2018), we believe more theoretical groundings around the concept of scale itself may lead to both the flexibility and the applicability needed to assess and, in turn, manage trans-scalar and trans-spatial WHSs as well as other heritage sites with equally complex geographies.

One of the reasons why, despite all of the best intentions, we rarely see a pure "heritage from below" approach effectively work within heritage landscapes is because the "below" is both non-homogenous and socially constructed (i.e. Muzaini and Minca, 2018). As Jonas (2011, p. 387) writes, people often assume both "quasi-fixed spatial forms" and "territorial hierarchies of different sizes." This "scale-as-hierarchy" perspective is what we often find within heritage and tourism literature and policy. However, again, as Jonas (2011, p. 388; original emphasis included) writes: "[i]n [the] . . . *scale-as-network* viewpoint, any given scale (i.e. the body) is examined not as a fixed hierarchy of territorial structures but instead as a network of overlapping and intermeshing patterns of association, the scale effects of which cannot be known *a priori*." Jones *et al.* (2011, p. 407) further add to such a debate by adding that "scales – as levels or hierarchies of space – do not exist" but are socially constructed and often politically motivated, yet simultaneously, and resultingly, "out of reach of everyday spatial life," and thus when mobilized, incapable of "confronting inequality, exploitation, and oppression."

A scalar politics or a "scale-as-network" approach to heritage and tourism would, in turn, critically reflect upon the interlocking stakeholders of heritage policy both regarding-yet-regardless of scalar hierarchy. For WHSs, in particular, while UNESCO itself does authenticate such sites, neither the designation nor the management of any site originates from a global (UN) scale, but rather, they are composed of varying and overlapping degrees of power, organizational and community relations. As Häkli (2018, p. 279) states, "a theoretical and methodological reevaluation of scalar thought is underway," combining existing scalar approaches, but also bringing in work which assembles tangible and intangible heritage meanings from the edges of fixed scalar thought. Such dynamic scalar (dis)ordering disrupts other dichotomies also found within heritage sites. If we no longer bound our perceptions to hierarchical and fixed scales of "the body" or "the community" or "the nation," similarly bounded heritage concepts such as the intangible or the natural may emerge and even intersect with heritage policy in new and creative ways (Hemsworth *et al.*, 2022). In such a way, Kaplan (2018, p. 43) argues that scale . . . reaching beyond its "vectored geometries . . ." can integrate concepts such as transnationalism, diaspora and hybridity into work which "cuts across flat territorial identities" and even act as "an active agent of change."

Framing our work around fluid scalar political relations, we engage with ongoing debates around the sustainability and management of industrial and WH. At the broadest level, UNESCO's adaptation of the UN's Sustainable Development Goals into their global strategy for WHS management has resulted in the beginnings of broader shifts within industrial heritage sites towards more holistic integration of sustainability. Khalaf (2022), argues that despite such increased integration of UNESCO and broader UN sustainable priority, the rigidity of UNESCO and ICOMOS heritage policy continues to focus on singular ideas of historic integrity rather than a future-oriented heritage which "embraces a more fluid or transformative continuity to accommodate change." One of our case studies, the Cornwall and West Devon Mining

Landscape, for instance, has "reassessed" the policies related to their management and reframed and rewrote them to prioritize, social equity, climate resilience and international partnerships between 2020 and 2025 (Boden, 2020, p. 14). This future-oriented direction offers a potential narrative and policy shift towards addressing long overshadowed violence embedded within industrial landscapes responsible for labor, environmental, racial and cultural exploitation (Mah, 2012; Rhodes *et al.*, 2021; Waterton, 2021).

World Heritage, in particular, often puts property, and its associated capital, over people (Khalaf, 2022). Li *et al.* (2023) argue that transcalar management of an integrated sustainable tourism and sustainable development model may both bring balance to conservation and development conflicts, but do so with the resiliency to offset the potential for economic and cultural disruption inherent at sites facing overtourism (c.f. Olya *et al.*, 2018). Despite high aspirations, many heritage and tourism scholars remain skeptical around UNESCO's potential for truly sustainable and resilient planning within WHSs, particularly planning, interpretation and/or development which addresses the violent histories of many sites (i.e. Lwoga, 2018). Logan and Larsen (2018, pp. 14–15) statie that "there are no indications that [the World Heritage Committee] would be ready to forego major growth opportunities for the sake of distant sustainability targets" and that "the evidence currently points more in the direction of heritage properties becoming islands of intensive growth, tourism and elite consumption, rather than alternative spaces of de-growth, social empowerment and inclusion." One direction within WH planning (according to some showing the most potential) is the diversification of power within the designation and management of a site. Bui *et al.* (2020), de Marco *et al.* (2018) and Adie and Amore (2020) argue that cross-scalar, transboundary and more evenly distributed networked governance are not just key to the management of WHSs but broader practices of sustainability and resilience. Berger (2020, p. 21) puts such arguments into perspective within industrial heritage by stating that "the more institutions there are and the better endowed they are, the more it will support the maintenance of a public memory of an industrial past," in-turn resulting in more democratic processes for which to address past injustices and shape more equitable futures [1].

Industrial heritage sites navigate complicated histories of extraction and displacement—labor exploitation, environmental degradation, community reorganization—and often return to these narratives with a degree of historical nostalgia as their industrial heritage transforms into a heritage industry (Rhodes *et al.*, 2021; Zwegers, 2022). Mining heritage, however, often sets some of its own specific patterns as mining landscapes relayed more directly upon its surrounding environment, often drove settlement more directly than some other industries which were able to locate near labor sources or transportation sources, and rarely escaped the most extreme of the boom-bust industrial economic cycle. How then does tourism and industrial heritage, particularly at the World Heritage Scale, intersect with mining landscapes? Boom and bust drive much of the heritagization of mining landscapes and, in turn, can result in its own risky, exclusionary or extractive economies. Walker (2021) discusses the obfuscation of continued lived experiences of industrial landscapes post-mining in places such as the Blaenavon Industrial Landscape. The importance of lived experience, memory and telling the complex stories of loss and belonging that often accompany mining landscapes also emerges in research from England (Emery, 2018), Bolivia (Perreault, 2018) and New Zealand (Bowring, 2021). These global connections also emerge from Rhodes's (2021) work on the new Slate Landscape of Northwest Wales WHS which engages the primitive accumulation of wealth through slavery and sugar plantations. Thistle and Langston (2016) reflect similar transnational impacts of contemporary mining landscapes from their more explicitly environmental entanglements, and Gohman (2013) makes the argument that industrial heritage should include these "wasted" landscapes in their historical narratives. Price and Rhodes (2020), for instance, found that while the Blaenavon Industrial Landscape, like its northern slate counterpart, also addresses the impacts of labor in a way that many mining museums do not, the Big Pit does very little, and audiences take almost nothing away, to address the intimate connections between coal mining and the critical status of our ongoing climate crisis. Price (2021) isolates the importance of politicization in mining heritage landscapes comparing the three National Coal Mining Museums of Britain. The sites of Japan's Meiji Industrial Revolution WHS also signals

that the politicization of mining heritage does not just occur at the national scale, but also transnationally as both Nakano (2021) and Johnsen (2021) write of the political use of Western industrial heritage experts to legitimize internally contested heritage, such as continued absences of forced labor narratives across the site. Finally, given the boom and bust of mining, the commercial endeavor of mining heritage often emerges as a or the most significant element as cities, regions, nations and states aim to replace industrial mining with industrial heritage, drive tourism revenue and inspire broader redevelopment (Reeves and Mountford, 2022; Berkenbosch *et al.*, 2022; Bergstrom, 2017; Dicks, 2014). The risks here, however, include replacing one boom-bust economic base with another, silencing contentious or controversial narratives, pushing out communities through processes of gentrification and commercializing or tokenizing cultural identity in the process. This literature would indeed indicate that more fluid scalar relations may open at least the potential for more sustainable and just futures within heritage landscapes by encompassing and addressing these often transnational economic, cultural and environmental heritage landscapes. It is within such a vein of thought that we proceed with this study, exploring three industrial WHSs to better understand how their scalar politics may or may not correlate with their sustainable futures.

Case studies and methods

To investigate the intersecting sustainable and policy-oriented geographies of tourism and heritage at industrial WHSs, we chose three case studies: the Blaenavon Industrial Landscape (BIL) WHS, the Cornwall and West Devon Mining Landscape (CWDML) WHS and Las Médulas WHS. These three cases in Wales, England and Castile and León, respectively, illustrate a diversity of geographies, political management and historical narratives from the broader range of industrial WHSs, particularly those found throughout Europe. In case selection, our own familiarity with these sites and the Welsh, English and Spanish languages further influenced our selection.

Framed within a scalar and landscape perspective and blending landscape and discourse analysis of in-depth interviews and photographic landscape documentation, these three case studies help to illustrate the discourses at play within the spaces and scales of the WHSs. Our interviewers were semi-structured with heritage site stakeholders identified using snowball sampling and approved by our institution's ethics board. All interviews (8 in BIL, 6 in CWDML, 5 in Las Médulas) were transcribed (and translated if necessary) and coded for reference to scalar politics and tourism. Our visual methods documented scalar politics as they may be represented within the landscape (i.e. endorsement labels, directional or ownership signage, interpretive texts, infrastructure, etc . . .) and were similarly coded. We applied discourse analysis to visual and descriptive codes. We frame our following discussion around these two methods across the three sites, pulling scalar discourse primarily from interview data and landscape discourse from photographic data.

Blaenavon

Established in 2000, the BIL aims to highlight the "outstanding universal value" of its industrial landscape and material culture reflecting 19th century industrial production and associated social and economic structures. Located on the eastern edge of the South Wales Coalfield and having equally rich deposits of iron, the town of Blaenavon, situated within one of the many South Wales Valleys, post-coal production in 1980 has come to reflect much of the cultural and economic stature of a deindustrializing Wales in the 21st century. After the Big Pit closed in 1980 and what was to become the National Coal Museum opened in 1983 and Cadw (the Welsh heritage office) spent £300,000 on restorations for the Blaenavon Ironworks, the industry of the town very clearly, and relatively swiftly, shifted towards industrial heritage tourism (Knight, 2016). The WHS itself encompasses the entirety of the town, built around the valley stream, reaching up the western ridge to the site of the Big Pit mine and up and over the eastern ridge down into the adjacent valley which held vital canal infrastructure needed for transporting materials.

Scalar discourse

Overall in Blaenavon, industrial heritage stakeholders point towards very different understandings of cooperation and association across the physical sites operating within the town. Some vocalized robust and productive relationships while others spoke of an utter lack of interaction while referencing the very same institutions and sites. Qualitative data point towards a general sense of ambivalence from and/or by many of the sites, particularly those whose funding and/or management originates at the national level. One stakeholder, when referencing the World Heritage status of some of the more nationally-funded organizations within the WHS, explicitly stated, "they don't need it." Other than the World Heritage Centre, built in heart of the town alongside their library, many of the individual industrial heritage sites across the BIL made few changes explicitly for WH Status, curatorially or logistically, speaking. One stakeholder, quite bluntly responded to our question with "[n]o, we carried on as normal, from a personal point of view."

Despite being a contiguous unit, stakeholders of the BIL range from a museum branch of National Museum Wales, a Cadw-run heritage site, a visitor center maintained by the Blaenavon Town Council but supported by the Torfaen County Council who manage the WHS, yet the BIL also reaches into Brecon Beacons National Park and Monmouthshire County who, along with other national and local stakeholders, also have political representation on Blaenavon Partnership board which oversees the management of the WHS. While some of these nuances came out in conversation, particularly some challenging power dynamics between the town and county councils, few stakeholders engaged much in the day-to-day political geographies of management at the site.

A second focus within stakeholder discourse emerged as a physical disconnect between particularly the Big Pit National Coal Museum which while not the hub of the WHS, is by far the most visited site within the designation, and the rest of the site's significant elements, particularly within the town. The lack of reliable public transit separates the town from its peripheral sites, particularly Big Pit, and both Big Pit staff, and stakeholders at most other sites indicated the tendency for visitors to drive directly to the museum, and bypass the town in both directions.

Stakeholders described UNESCO and WH in the following ways:

(1) Branding, especially for international visitors

(2) Behind the scenes with marketing and event organizing

(3) Process of funding and developing the town, "at least aesthetically"

(4) A promotional tool to increase awareness and leverage funding

(5) It institutionalizes community partnership

While five different threads, there is a common pattern throughout of communication and branding. The requirement of the Blaenavon Partnership, mandated by UNESCO's requirement for both a management plan and central management agency, doesn't just force community partnership (however successful that may or may not be or be perceived). As one stakeholder stated, UNESCO provides their institution with a mandate for community engagement. Without it, there may be difficulties for a national or international organization to see the value of such close localized coordination and partnership.

Landscapes discourse

Branding also emerged as the clearest and most prominent discourse from the landscape analysis of the WHS. The use of "Heritage Town" to brand Blaenavon can be found in the town, outside of the town, upon entrance to the town. The welcome signs do not just read "Welcome to Blaenavon", but "Welcome to Blaenavon Heritage Town" all in the same font (Plate 1). In this way the Town Council is very much scaling itself up.

Accompanying the Heritage Town text is also the BIL logo. A miner resting upon a shovel in the abstract, gazing up and away at the bright sun and with their back turned to the back foreground of

Plate 1 A welcome sign to Blaenavon Heritage Town

Source(s): Photo by author

the logo. Perhaps this beacon of light is pointing away from the economic collapse of the coal industry in the South Wales Valleys which hit Blaenavon particularly hard and towards their brighter future of industrial heritage-led development? In any case, this logo can be found throughout the entirety of the WHS, including well beyond the town borders in the adjacent valley where canal infrastructure remains (See Plate 2).

Interestingly, while the use of the logo and the use of the word heritage are both prevalent (you can find chippies, funeral homes, petrol stations and lodging using the word heritage, some prominently displaying the site iconography), the connections between "heritage town" and the BIL and WH or UNESCO are less than prominent. While the WH Centre obviously makes the connection, the Ironworks has two signs to the WHS, the town museum has one, and Big Pit has two mentions, the presence of "World" heritage throughout the landscape is somewhat muted. At Keepers Pond outside of town in Brecon Beacons National Park, for instance, of the two BIL signs, only one mentions WH or uses the UNESCO logo, while the other only connects up to the National Park and the European Union (Plate 3). Both signs, however use the BIL logo. Even more absent is the scalar power of the Welsh Government in the landscape, speaking perhaps more towards the early years of the Blaenavon redevelopment when the Welsh Assembly was still forming than anything else. Throughout the town's heritage landscapes outside of specific sites, only one series of signs recognizes the Welsh Government, and even at the Cadw (i.e. Welsh Government) run Blaenavon Ironworks, the BIL logo and the connections to UNESCO and WH are actually more prominent than either Cadw or the Welsh Government.

Cornwall and West Devon

Like Blaenavon, the CWDML was one of the UK's earliest tentative industrial sites. Established in 2006, two significant differences separate it from Blaenavon. First, while Blaenavon sits under

Plate 2 A Bannau Brycheiniog National Park sign using a small BIL logo

Source(s): Photo by author

devolved Welsh Government authority, CWDML falls under English and UK heritage planning. As Zwegers (2022, p. 172) notes, this both eased and exacerbated late-twentieth century political movements for Cornwall to receive their own devolved powers from the UK Government. WH Status allowed for this region, which had been suffering from deindustrialization, second-home ownership and the economic and cultural impacts of overtourism for over a century to instead "bypass London" in their heritage policy. But while WH status did help elevate industrial heritage closer to that of coastal and Celtic heritage, it did not significantly shift Cornwall's political position within England. The second major difference between CWDML and the other cases is the spatial scope of the site: composed of ten geographically discontiguous areas forming a 20,000 hectare site with dozens of disparately owned and operated elements scattered across 360,000 hectares. Politically, the site is managed by the Cornwall County Council, but overseen by a consortium of representatives from the Cornwall County Council, Devon County Council and West Devon Borough Council.

Scalar discourse

While scalar tensions of political discourse existed within the BIL, being bounded within more simplistic political bounds with a clearly identifiable core sets the BIL apart from the CWDML, as does the clear distinction between revitalizing a heavily deindustrialized landscape surrounding a mining landscape in South Wales and a highly varied set of 10 unique and economically and environmentally diverse areas in the CWDML. Half of the 10 Areas of the WHS are located on the coast. In these cases, we found that WH remains peripheral to Heritage Coast tourism. Even in cases where these two intersect—primarily in locations used for the popular 2015–2019 *Poldark* television series—industrial or WH falls second to media tourism often to the mixed reception of stakeholders who acknowledge the role of the sea (and the popularity of the imagined Cornish coastal landscape) in bringing in the tourists who keep their industrial heritage sites in operation but nonetheless lament the disregard for the richness of the cultural heritage many tourists perform.

Outside of these five coastal Areas, the five inland Areas follow a more similar pattern of utilizing WHS branding to bring in more cultural tourism in the face of deindustrialization. Many

stakeholders also noted the use of the WHS to bring greater attention to Cornishness—elevating music and language. Instead, most coastal towns do not or cannot utilize the WHS branding for fear of increasing already past capacity tourism infrastructure.

While stakeholders across all sites looked upon WHS favorably, few saw it as much beyond a branding strategy. Their generalized responses UNESCO's can be summarized as follows:

(1) Minimal and narrow connector

(2) A mark of approval affirming cultural significance

(3) Protection, education and a branding campaign

(4) A loose partnership and management brand

(5) Education and Preservation

(6) Gives official recognition to the history and landscape

Overall, most stakeholders were more interested in *spatial* rather than *scalar* partnerships. There have been various attempts at collaboration since the creation of the WHS, but funding and time continue to be significant barriers. It is currently up to each site to determine for themselves how best to integrate or not into the WHS. As Cornwall Council funding has dried up for most heritage projects beyond building conservation, however, sites are beginning to re-explore the potential for a more integrated partnership. Such spatial integration will also be impacted by the success or failure of the recently implemented scalar systems of integration. As of 2022, a hub and spoke system is now in place for the CWDML, where Geevor Mine in the west, the centrally located Wheal Martyn and Tavistock in the east now function as the three hubs of not only their specific Areas of the WHS (1, 8 and 10, respectively), but for the entirety of CWDML, providing overarching interpretation for the entire WHS. Future research into the impacts of these interspatial and interscalar heritage relationships will be necessary.

One source of struggle has been the CWDML logo, with an engine house and stack on a curved horizon with the phrase "Cornish Mining World Heritage," "Cornish mining", to some in Devon, indicates a form of erasure of the West Devon contribution (Plate 4). The struggle exacerbates underlying tensions over the role of industrial heritage landscapes throughout Devon which some argue should have been included in the original WH bid. For some in Cornwall, they see "Cornish Mining" as appropriate given the origins of the technology and the geology of the region. To help

Plate 3 The redesigned CWDML logo

Source(s): Photo by author

ease tensions, the Cornwall Council developed an alternative logo with the phrase "World Heritage Site." Interestingly, however, even after the development of this new alternative logo, heritage sites in West Devon continue to use the old logo, indicating that these tensions were not as universal across scales as our interview data indicated.

Landscape discourse

Building upon the visual tensions of the logo, unlike Blaenavon, the landscape of the CWDML displays very disparate uses of marketing, labeling and engagement with WH Status. Hayle, St. Agnus, Luxulyan Valley and Tregonning, (Areas 2, 3, 7 and 8) had little to no recognition of the WHS. Landscape elements only included a very small obscure QR codes in Hayle, a single temporary sign in St. Agnus, a couple WHS references in Charlestown and the Luxulyan Valley adjacent transit stations, and a single sign at the Godolphin National Trust site in the Tregonning Mining District. These landscapes stand in stark contrast to Redruth and Camborne or Tavistock (Areas 5 and 10) where WH has been integrated literally into the center of those cities, often used for place-making and branding across public infrastructure (Plates 5 and 6). Beyond public use of WH in branding, a contrast between our other two cases and the CWDML that stood out was the use of WHS branding by private companies … particularly the two major rail companies operating in Cornwall: Great Western Railway and CrossCountry. Both companies, use UNESCO and WH quite liberally throughout their tourism marketing and branding at stations throughout the region, but very rarely mention the name of the WHS, leading us to question its overall impact, if any.

Another central theme to the landscape discourse of the CWDML is an overarching focus on emigration within the heritage narratives, unique emigrant-focused sites and the significance of twin-towns. The Diaspora Gardens and emigrant focus at Heartlands Cornish Heritage and Culture Centre in Pool, the prominent school mural at the Plymouth railway station, and Cornwall and Devon's many city twinnings illustrate an ongoing theme of global connection at the heart of the CWDML discourse. It is relatively unique to find a WHS rely upon absence (i.e. its emigrant population) as a key contributor to historical significance.

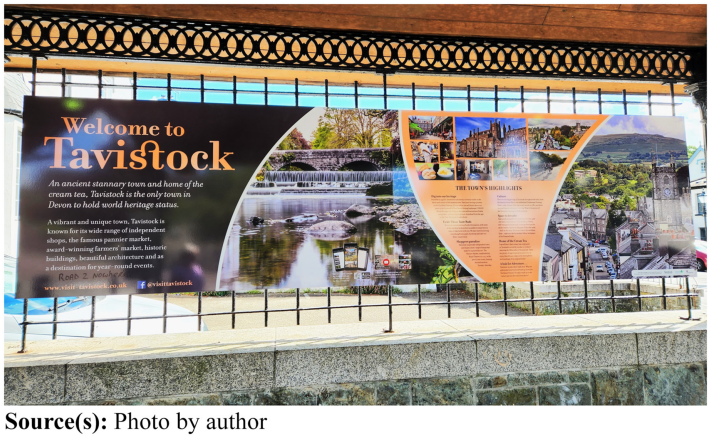
Las Médulas

Las Médulas was designated a WHS in 1997, a natural heritage site by Castile and León in 2002, and a cultural heritage site by Castile and León in 2010. As an overarching tourism site, Las

Plate 4 Sign at the center of the city of Redruth

Source(s): Photo by author

Plate 5 Welcome banner to Tavistock



Source(s): Photo by author

Médulas is managed by four municipalities, Carucedo, Orellán, Borrenes and Puente Domingo Flórez, with the regional government of Castile and León and generous input from the *Comarca*, El Bierzo, which is a special administrative zone overseeing tourism and culture in the area. We interviewed six stakeholders from across this complex network. The WHS's primary purpose is to distinguish and contextualize place temporally (across Celtic, Roman and ongoing local history) and spatially, by situating the region within Spain and Europe in relation to the Roman gold mines and aqueducts of the region. Las Médulas is also an active archaeological site, and is situated within a protected natural area; *Sierra de Carucedo.* Archeology at the site is primarily managed by the Spanish national government via the Ministry of Culture and the National Institute of Cultural Heritage. Another key entity in the management of Las Médulas is the Las Médulas Foundation: a non-profit established in 1992 between the University of León, the Comarca of El Bierzo and other organizations for marketing, fundraising, visitor services and education.

Scalar discourse

In Spain, there has been a reconceptualization of tourism since the 1980s, shifting from "*sol y playa*" "sun and beach" to *"sol, playa, y patrimonio*" "sun, beach, and heritage" (Martin De la Rosa, 2003; Ponferrada, 2015). Amongst this shift, tourism has steadily increased at Las Médulas, booming during the pandemic, as many Spaniards sought out sites off the beaten path and those located in open-air environments, such as cultural WHSs, Castillo-Manzano *et al.* (2021).

The Archaeological center In Las Médulas focuses on the more historical aspects of the area while the visitor center in Carucero is focused on environmental aspects. Both of these centers work for the regional government of Castile and León. When asked about the goals of the WHS, stakeholders provided the following four generalized answers:

(1) Tourism

(2) To distinguish and contextualize heritage

(3) Coordinate management

(4) Just a designation, little more

Two interviewees responded to our question, "what are your thoughts about tourism in this region" with nervous laughter. They describe the deindustrialized economy of the region as driving tourism, but that the tourism is "not managed well." They describe this within the state-wide problem of

"touristification:" impacting Las Médulas through erosion, cave-ins and the "masses of people" who visit the village of Las Médulas during the high season.

Tourist diversification was touched on by many. According to stakeholders, this diversity is needed in multiple forms:

(1) Length of stay, particularly longer stays.

(2) Seasonality, particularly non-summer visitors

(3) International and education tourists, particularly those interested in the history of the mine itself.

Work has been ongoing to link different types of tourists to the "rural route" which draws upon the nearby Camino De Santiago, and the Casas Rurales system (a nationwide rural-focused combination of hotels.com and Airbnb). These rural tourism initiatives have seen significant "success" in total numbers of tourists, but not in spatial diversity.

Despite the site's scalar complexity, on its face, it seems simple to visitors; Las Médulas WHS is in Las Médulas village. However, in reality, the village boundaries do not match the WHS. Many canals and mine workings fall outside of the designated borders, and many entities are within the border of the site but not recognized as such by the public. This was a sore spot among some, who expressed dissatisfaction with the fact that the name of the WHS matches the name of one of its towns. According to interviewees, this leads to confusion surrounding the extent of the site, which in turn leads to an underappreciation for the breadth of the industrial landscape. This also contributes to over-tourism within the village of Las Médulas itself: a chokepoint for cars, people and capital. Even during the course of our research at the site (2019–2022), we witnessed the closure of caverns and mines into which tourists could previously venture. Interviewees stressed that tourism should be sustainable, but that this is impossible when all tourists arrive in the summer. The site receives upwards of 2000 people per day in the four villages (which range from 38 to 1,852 inhabitants). Some spoke of implementing an entrance fee to help support infrastructure, however such implementation is not agreed upon by all municipalities, nor the regional management institutions.

The other chokepoint in Las Médulas is the lookout in Orellán. Many day trippers drive into the village of Las Médulas and take a 20–30 min walk, have lunch and then drive through Orellán, and up to the lookout point for a photo. Many others, however, will only drive through Orellán, snap a photo and then be on their way. This is seen as a missed opportunity to inform visitors and promote sustainable tourism. Stakeholders in the village near the lookout see it as a drain on their resources due to the wear and tear on infrastructure. The issue of seasonal tourism and over-tourism was one of the key themes across interviews from hotel owners, archeologists and managers, with stakeholders using the term "touristificació" to describe the negative impact on the local community and environment.

Landscape discourse

The landscape of Las Médulas illustrates the complexity and, at times, confusion surrounding the scalar network of the site. The presence of WHS signage is almost everywhere but is nearly equal to signage for other designations at the regional level. Few EU or state scale references are present, despite the interviewee's statements about the importance of the federal government. While there is a focus on Roman history at the Archaeological House within the core of the WHS, the Roman museum in Carucedo and the ruin site in the same town don't mention the WHS.

Directional signage overlaps with other signs for tourist routes on the landscape, including the Camino de Santiago, the Camino Real and other rural tourist routes (Plate 2). Tourists using these sites often depend on a network of Casas Rurales, or rural houses in which to stay. Designations of hotels within this network emblaze many buildings in the area, some of which also attach WHS logos.

Directional signage surrounding the site consistently points visitors towards the village of Las Médulas, even when signs rest within the boundaries of the WHS site itself (Plate 7). This illustrates

Plate 6 An advertisement for the Camino Real in Las Médulas

Source(s): Photo by author

the guidance that management gives tourists to head to the "chokepoint" of Las Médulas Village to experience a site that they don't know they are already in. Conversely, the natural monument education center in Carucedo, apart from a single outdoor steel statue of the UNESCO symbol, does little to engage with the WHS designation, despite having ample information about the roman ruins and aqueducts in the region.

Discussion

The sustainability of scalar politics in world heritage

In all three case studies, stakeholder discourse illustrates the potential for the sort of transcalar "vectored geometries" at play in the WHSs. A lack of universal application across scalar relations also supports a complicating narrative. In Las Médulas, the local community name reflected in the name of the WHS is a point of contention, whereas that same result in Blaenavon was a point of contention not because of the economic and cultural power that such a name gives to a singular municipality within a larger site but because the political powers assumed to accompany such a designation in Blaenavon actually reside more with the larger county council rather than with the town council.

While elsewhere we look into the specific spatialities of these sites and where stakeholders do or do not perceive each site to be bounded, a more simplistic spatiality around the scalar politics of these sites also stands out. In Las Médulas, both the titular village and the very popular Orllán overlook pull attention away from the wider geographies of the Site. In Blaenavon, a similar process happens between Big Pit and to a lesser extent the Blaenavon Ironworks. In Cornwall, while a tension arises between the common shortening of the site to "Cornish Mining," particularly with those in West Devon, overall, much less spatially-fueled conflict surfaces within the data. Instead, the geographies of the WHS seep well beyond the boundaries of the WHS into a hub location beyond the boundaries of the WHS and contract from several key areas which see little value in embracing the designation. These heritage geographies balance both fluid heritage policy and management yet reflect the need to not abandon scalar inquiry. Stakeholders and landscapes across all three sites reinforce an understanding of scale as simultaneously hierarchical, networked and fluid (Jonas, 2011; Kaplan, 2018).

Overall, the sustainability of scalar politics falls significantly upon the management structure of these sites, particularly the support provided from overarching political units and agency given to individual elements and areas within each site. In Spain, the overarching units take a heavy-handed approach, which is appreciated by some, but without agency to self-navigate and self-manage the site, scalar tensions arise. In Cornwall and West Devon, while there is significant agency, financial support has all-

Plate 7 A Camino Real sign in the village of Puente Domingo Flórez within the Las Médulas WHS boundaries with a UNESCO logo pointing walkers towards the villages of Las Médulas and Yeres, both also within the boundaries of the Las Médulas WHS

Source(s): Photo by author

but fallen away and stakeholders are seeking alternatives means of (re)making scalar and spatial connections. In Wales, there exists both a scalar limitation whereby smaller elements feel overshadowed and passed over by the larger institutions and political leaders, particularly in cases where larger institutions do not have to rely upon local political leadership. None of these sites elicit a top-down or bottom-up "problem" but issues navigating, managing and communicating across scalar relations. In all cases, a global designation has been laid upon a site managed by national, regional, municipal and privately owned organizations and institutions. Landscapes and stakeholders across these sites however point away from clean breaks and clearly organized social and political structures and towards the fluidity of scalar relations (Jones *et al.*, 2011).

Scalar fluidity and sustainable tourism

One of the most significant challenges which emerges out of the establishment of industrial WHSs pertains to physical mobility and accessibility. As relatively rural and spatially dispersed and discontinuous sites, all three suffered (to varying degrees) from limited public transportation and infrastructure connections. No public transportation to Las Médulas exists, and while regular buses (and less regular trains) frequent the perceived core areas of Blaenavon and the CWDML, traveling to the peripheries of these two sites can be challenging if not impossible using public transport. Most stakeholders indicated that overtourism, and parking, in particular, were concerns during the summer months. Given the rurality of these sites, the wear and capacity of the infrastructure is not able to keep up with the marketing. St. Just and Cornwall Council, however, have implemented best practices which take the scalar fluidity of their WHS into consideration. The Tin Rover public bus line follows the coast and provides accessibility to several elements within the WHS while also serving local populations and not isolating the route to a single area or attraction found within the site. With a capped rate for public transit, at least

across Cornwall, sustainable transportation is taking precedence to sustainable tourism, making sustainable transportation more accessible to everyone, including tourists.

The second challenge found within these fluid scales of industrial heritage management results in complications and contestations around interpretation. While competition certainly emerges within each site, these industrial heritage sites and the regions to which they are tied, are also in fierce competition with other industrial heritage sites and regions. Perhaps this is more of a concern of the governing bodies and the traditional tourism sectors of their regions, but Berkenbosch *et al.* (2022) make a compelling argument that not only are regional economies set against one another within a boosteristic neoliberal tourism economy, but industrial heritage (the Ruhr, in their case) specifically helps to pave the way for regional rebranding and reconsideration of the possibilities of a consumer rather than extractive economy. Sustainable tourism, then, must keep in mind that while scales are indeed fluid, they have become fixed upon very realized institutions, and many institutions have a vested interest in restricting the fluidity, as well as the mobility across, of scales and scalar relations in competition for increased profit and tourism growth.

Conclusions

Overall, our cases demonstrate the benefits of WHSs within industrial landscapes as limited. Laying a global scale of heritage designation upon already contentious scalar relations within an industrial heritage region appears to simply exacerbate those existing tensions. Given the lack of additional funding, those elements within a site with the means, infrastructure and capacity in time and resources to capitalize upon the branding and marketing of WH allows them to benefit over smaller sites who have less political or economic regional power. Interview data reveals that not only do those with less power within these heritage structures tend to lack the time and financial resources to compete with larger elements, there is significant disappointment which accompanies a post-designation climate where promises of synergistic marketing and funding opportunities do not materialize. These smaller organizations often do not have the capacity to transform the social capital of World Heritage status into economic capital for material improvements to their heritage sites. Without staff with dedicated marketing and grant-writing capacity, smaller sites are put into a more disadvantaged position.

One the other hand, however, when WH status is presented and considered as little more than a designation, a tag which signifies value but does not necessary add, or promise to add, value, then WH Status within industrial heritage landscapes has little to disappoint. Across all three sites we see the utilization of industrial "World Heritage" branding for the purpose of economic redevelopment within deindustrialized space. Blaenavon's high street, the rural villages around Las Médulas and the central cities of the Cornish Peninsula all reflect the shift from post-mining regions to industrial heritage-driven tourism and redevelopment. Given the disadvantaged economic status of many deindustrialized industrial heritage regions, few (if any) have found true success in simply swapping an economic base of natural resource extraction with tourism. As Azcárate (2020) exclaims, tourism, in many ways, is yet another extractive industry, appropriating cultures and extracting labor from local and migrant populations who work in the often seasonal, part-time and highly unstable tourism service economy.

If our cases are pointing towards a possible future where WH status at industrial sites is simply a designation with little additional value, what implications does that indicate? Industrial heritage sites need to take their scalar relations into account prior to designation and not rely upon WHS status to fix existing problems. We are not arguing that Outstanding Universal Value cannot be found across all three of our case studies, but we can also find similarities to studies such as Nakano's (2021) work at the Sites of Japan's Meiji Industrial Revolution WHS or Walker's (2021) work adjacent to the Blaenavon Industrial Landscape where industrial World Heritage both obscures the depth of these values and reflects unevenness of values across a landscape, often stemming from the politicization of heritage. Establishing an interconnected and highly communicative yet still nimble network where sites have agency but can still rely upon some centralized funding source to enable

the sustainability of not only the network but the sites and the region itself seems to be key. Keeping in mind the spatialities of these sites also points to the consideration of the naming of the site. Avoiding naming the site in such a way which spatially highlights a single stakeholder also appears key to maintaining not only sustainable networks across the broader heritage site but sustainable tourism, as well. In each case, fluid scalar networks indeed assist more than hinder sustainable management of industrial heritage.

We set out to expand and explore the role that geographers, and our spatial and scalar methods, may play in the assessment and interpretations of industrial heritage sites, particularly those designated through UNESCO. The implications of these assessments fall alongside a growing number of industrial World Heritage Sites where 21% of new WHSs in the past five years have been industrial, while only 8% were in the first five years of the convention. Disparate geographies, serial listings and transnational designations have also been increasing to a point where 65% of new World Heritage Sites and 67% of new industrial World Heritage Sites do not contain contiguous borders. Scale, in particular, and approaching each site relatively systematically via the designation, management and political intersections of the heritage sites, enabled not only a clearer analysis of each site but the ability to more clearly cross-analyze stakeholder responses and policy documents. Landscape, while certainly useful to provide context to elements within each site and also highlight broader spatial and scalar patterns and/or anomalies, was less useful in a cross-comparative sense, particularly when we were unable to visit the totality of the CWDML. Overall, however, we found a scalar approach significantly more effective in addressing questions of sustainable management, tourism and heritage within, and particularly across, the diversity of industrial World Heritage.

Acknowledgment

We would like to acknowledge the many hours of assistance and knowledge shared with us by the staff (employed and volunteered) in Blaenavon, Las Médulas, Carucedo, Orellán and across the entirety of the CWDML, particularly individuals within the Institute of Cornish Studies and the Cornwall County Council. We also want to thank our fellow faculty and the students within Michigan Technological University's Industrial Heritage and Archaeology MS and PhD programs for their atmosphere of critical contemplation and support. Funding was generously provided by Michigan Tech's Vice President for Research Office's Research Excellence Fund.

Notes

1. More democratic, however, does not necessarily mean less conflict. Taormina and Bonini Baraldi (2022) find the ever-increasingly complex partnerships within the policies of World Heritage Sites does indeed generate increased public participation, but that participation, at least in urban sites, actually tends to emerge from conflicts resulting from the WHS as much as the strategic planning of the WHSs themselves.

References

Adie, B.A. and Amore, A. (2020), "Transnational World Heritage, (meta) governance and implications for tourism: an Italian case", *Annals of Tourism Research*, Vol. 80, 102844, doi: 10.1016/j.annals.2019.102844.

Azcárate, M.C. (2020), *Stuck with Tourism: Space, Power, and Labor in Contemporary Yucatán*, University of California Press, Oakland, California.

Battisti, C. and Fanelli, G. (2015), "Don't think local! Scale in conservation, parochialism, dogmatic bureaucracy and the implementing of the European Directives", *Journal for Nature Conservation*, Vol. 24, pp. 24-30, doi: 10.1016/j.jnc.2015.01.005.

Berger, S. (2020), *Constructing Industrial Pasts. Heritage, Historical Culture and Identity in Regions Undergoing Structural Economic Transformation*, Berghahn Books, New York, New York.

Bergstrom, R.D. (2017), "The curious case of Cuyuna: re–envisioning former extractive sites to stimulate local communities", *The Extractive Industries and Society*, Vol. 4 No. 4, pp. 860-868, doi: 10.1016/j.exis.2017.10.005.

Berkenbosch, K., Groote, P. and Stoffelen, A. (2022), "Industrial heritage in tourism marketing: legitimizing post-industrial development strategies of the Ruhr Region, Germany", *Journal of Heritage Tourism*, Vol. 17 No. 3, pp. 327-341, doi: 10.1080/1743873x.2022.2026364.

Boden, D. (2020), *The Cornwall and West Devon Mining Landscape World Heritage Site Management Plan 2020-2025*, Cornwall County Council, Truro, Cornwall.

Bowring, J. (2021), "An affective absence: memorialising loss at Pike river mine, New Zealand", *Emotion, Space and Society*, Vol. 41, 100845, doi: 10.1016/j.emospa.2021.100845.

Bui, H.T., Jones, T.E., Weaver, D.B. and Le, A. (2020), "The adaptive resilience of living cultural heritage in a tourism destination", *Journal of Sustainable Tourism*, Vol. 28 No. 7, pp. 1022-1040, doi: 10.1080/09669582.2020.1717503.

Castillo-Manzano, J.I., Castro-Nuño, M., Lopez-Valpuesta, L. and Zarzoso, Á. (2021), "Assessing the tourism attractiveness of world heritage sites: the case of Spain", *Journal of Cultural Heritage*, Vol. 48, pp. 305-311, doi: 10.1016/j.culher.2020.12.005.

de Marco, L., Denyer, S., Durighello, R. and Yıldırım, E. (2018), "'No past, no future?' an ICOMOS perspective on cultural heritage and the sustainability agenda", in *World Heritage and Sustainable Development*, Routledge, pp. 168-179.

Dicks, B. (2014), "Participatory community regeneration: a discussion of risks, accountability and crisis in devolved Wales", *Urban Studies*, Vol. 51 No. 5, pp. 959-977, doi: 10.1177/0042098013493023.

Emery, J. (2018), "Belonging, memory and history in the north Nottinghamshire coalfield", *Journal of Historical Geography*, Vol. 59, pp. 77-89, doi: 10.1016/j.jhg.2017.11.004.

Gohman, S.M. (2013), "It's not time to Be wasted: identifying, evaluating, and appreciating mine wastes in Michigan's copper country", *The Journal of the Society For Industrial Archaeology*, Vol. 39 Nos 1-2, pp. 5-22.

Häkli, J. (2018), "Transcending scale?", Herb, G. and Kaplan, D. (Eds), *Scaling Identities: Nationalism and Territoriality*, Sage, pp.271-282.

Hemsworth, K., Greer, K., Paulin, M., Sutherland, K. and McLeod Shabogesic, J. (2022), "Maada'oonidiwag gete-dibaajimowen ('sharing old stories'): reflections on a place-based reparatory research partnership in Nbisiing Anishinaabeg Territory", *GeoJournal*, Vol. 87 No. 2, pp. 267-280, doi: 10.1007/s10708-021-10432-3.

James, L. and Winter, T. (2017), "Expertise and the making of world heritage policy", *International Journal of Cultural Policy*, Vol. 23 No. 1, pp. 36-51, doi: 10.1080/10286632.2015.1035267.

Johnsen, N. (2021), "Katō Kōko's Meiji industrial revolution – forgetting forced labour to celebrate Japan's world heritage sites – Part 1", *The Asia-Pacific Journal: Japan Focus*, Vol. 19 No. 23, pp. 1-19.

Jonas, A.E. (2011), "Scale and networks: Part I", in *The Wiley-Blackwell Companion to Human Geography*, pp. 387-403.

Jones, J.P. III, Marston, S.A. and Woodward, K. (2011), "Scales and networks", in *A Companion to Human Geography*, Wiley-Blackwell, pp. 404-414.

Kaplan, D.H. (2018), "National identity and scalar processes", in *Scaling Identities: Nationalism and Territoriality*, pp. 31-48.

Khalaf, R.W. (2022), "Integrity: enabling a future-oriented approach to cultural heritage", *The Historic Environment: Policy and Practice*, Vol. 13 No. 1, pp. 5-27, doi: 10.1080/17567505.2021.1981670.

Knight, J. (2016), *Blaenavon: From Iron Town to World Heritage Site*, Logaston Press, Eardisley, Hereford.

Li, J., Yang, C., Zhu, Y. and Han, F. (2023), "How does the world heritage sustainable tourism programme guide the evolution of rural landscapes?", *Landscape Research*, Vol. 48 No. 4, pp. 517-530, doi: 10.1080/01426397.2023.2170995.

Logan, W. and Larsen, P.B. (2018), "Policy-making at the World Heritage-sustainable development interface: introductory remarks", Larsen, P.B. and Logan, W. (Eds), *World Heritage and Sustainable Development: New Directions in World Heritage Management*, Routledge, pp.3-20.

Lwoga, N.B. (2018), "Dilemma of local socio-economic perspectives in management of historic ruins in Kilwa Kisiwani World Heritage Site, Tanzania", *International Journal of Heritage Studies*, Vol. 24 No. 10, pp. 1019-1037, doi: 10.1080/13527258.2018.1430604.

Mah, A. (2012), *Industrial Ruination, Community, and Place: Landscapes and Legacies of Urban Decline*, University of Toronto Press, Toronto.

Martín De la Rosa, B. (2003), "Nuevos turistas en busca de un nuevo producto: el patrimonio cultural",Vol. 1 No. 2, pp. 155-160, doi: 10.25145/j.pasos.2003.01.015.

Muzaini, H. and Minca, C. (2018), *After Heritage: Critical Perspectives on Heritage from below*, Edward Elgar, Northampton, Massachusetts.

Nakano, R. (2021), "Mobilizing Meiji nostalgia and intentional forgetting in Japan's world heritage promotion", *International Journal of Asian Studies*, Vol. 18 No. 1, pp. 27-44, doi: 10.1017/s1479591420000467.

Odede, F., Perry, B. and Hayombe, P. (2022), "Community-based organizations in Kisumu: a necessary but not sufficient condition for managing polyvalent heritage landscapes", in *Landscape As Heritage*, Routledge, pp. 40-55.

Olya, H.G., Alipour, H. and Gavilyan, Y. (2018), "Different voices from community groups to support sustainable tourism development at Iranian world heritage sites: evidence from Bisotun", *Journal of Sustainable Tourism*, Vol. 26 No. 10, pp. 1728-1748, doi: 10.1080/09669582.2018.1511718.

Perreault, T. (2018), "Mining, meaning and memory in the Andes", *The Geographical Journal*, Vol. 184 No. 3, pp. 229-241, doi: 10.1111/geoj.12239.

Ponferrada, M.L.V. (2015), "Evolución del turismo en España: el turismo cultural", *International Journal of Scientific Management and Tourism*, Vol. 1 No. 4, pp. 75-95.

Price, W.R. and Rhodes, M.A. (2020), "Coal dust in the wind: interpreting the industrial past of South Wales", *Tourism Geographies*, Vol. 24 No. 405, pp. 837-858, doi: 10.1080/14616688.2020.1801825.

Price, W.R. (2021), "Unearthing community identities at the national mining museums of Great Britain", in Rhodes, M., Price, W.R. and Walker, A. (Eds), *Geographies of Post-Industrial Place, Memory, and Heritage*, Routledge, pp. 71-84.

Reeves, K. and Mountford, B. (2022), "All that glitters: telling the fiftieth anniversary story of gold at sovereign hill", *Journal of Heritage Tourism*, Vol. 17 No. 4, pp. 448-464, doi: 10.1080/1743873x.2022.2047708.

Rhodes, M.A. (2021), "Amgueddfa'r Gogledd: slate, slavery, and transatlantic labor in the National Slate Museum", in Rhodes, M., Price, W.R. and Walker, A. (Eds), *Geographies of Post-Industrial Place, Memory, and Heritage*, Routledge, pp. 185-200.

Rhodes, M.A., Price, W.R. and Walker, A. (2021), *Geographies of Post-industrial Place, Memory, and Heritage*, Routledge, Abingdon, Oxon.

Salazar, N.B. (2007), "Towards a global culture of heritage interpretation? Evidence from Indonesia and Tanzania", *Tourism Recreation Research*, Vol. 32 No. 3, pp. 23-30, doi: 10.1080/02508281.2007.11081536.

Thistle, J. and Langston, N. (2016), "Entangled histories: iron ore mining in Canada and the United States", *The Extractive Industries and Society*, Vol. 3 No. 2, pp. 269-277, doi: 10.1016/j.exis.2015.06.003.

Taormina, F. and Bonini Baraldi, S. (2022), "Unveiling forms of participation in the governance of UNESCO world heritage sites", *European Spatial Research and Policy*, Vol. 29 No. 2, pp. 79-91, doi: 10.18778/1231-1952.29.2.05.

Walker, A. (2021), "Everyday resonances of industrial pasts: considering lived and affective memories in ex-coal mining landscapes in a South Wales valley", in Rhodes, M., Price, W.R. and Walker, A. (Eds), *Geographies of Post-Industrial Place, Memory, and Heritage*, Routledge, pp. 52-67.

Waterton, E. (2021), "Epilogue: a coda for the 'Left Behind'-Heritage and more-than-representational theories", in *Transcending the Nostalgic: Landscapes of Postindustrial Europe beyond Representation*, Berghahn Books, pp. 235-252.

Zwegers, B. (2022), *Cultural Heritage in Transition A Multi-Level Perspective on World Heritage in Germany and the United Kingdom, 1970-2020*, Springer, Cham.

Corresponding author

Mark Alan Rhodes II can be contacted at: marhodes@mtu.edu