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Research Paper

Using geo-tagged Instagram posts to reveal landscape values around current and proposed hydroelectric dams and their reservoirs

Yan Chen[a,*], John R. Parkins[b], Kate Sherren[a]

[a] School for Resource and Environmental Studies, Dalhousie University, Halifax, Canada
[b] Department of Resource Economics and Environmental Sociology, University of Alberta, Edmonton, Canada

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ABSTRACT

Landscape values indicate how humans perceive and evaluate the landscape. In our study areas, two hydroelectric proposals have the potential to alter the landscape dramatically, particularly the river (reservoir) and riparian land. An understanding of the spatial patterns of landscape values, especially the social and cultural values which are intangible and underestimated in energy planning processes, can help decision makers to anticipate public concerns and adjust or abandon project proposals accordingly. Intangible landscape values can be revealed in part by leveraging social media. Such data sources have two benefits in relation to the challenges of previous, manual approaches: they give us access to people (e.g. youth) who are often absent in conventional participation methods, and provide large datasets at low cost. We collected photos and captions that were geo-tagged to the study areas on the social media site *Instagram*, and built a filtering model to increase validity of data for the calculation of point density (specifically, kernel density estimation). The density maps reveal that: (1) landscape values vary over space; (2) aesthetic value was most widespread (not surprising given typical uses of the *Instagram* platform); (3) town areas, especially the old ones, and popular viewpoints were most likely to be attractors for multiple values. People tend to accept and appreciate familiar landscapes, thus proponents should make particular allowances for locations of key values and multiplex values.

1. Introduction

Proposals that lead to water impoundment or river restoration call for a better understanding of landscape values held by local residents. Generally, energy proposals are often seen as disrupting and threatening people's perceptions of landscape, place attachment, and senses of self that are associated with physical and social environments (Collins & Kearns, 2010; Devine-Wright, 2009). Physical landscape changes can result in uncomfortable feelings like anxiety, threat, and a sense of loss and displacement (Atkins, Simmons, & Roberts, 1998; Devine-Wright, 2009; Kaplan, Kaplan, & Ryan, 1998). At the same time, community-based support networks can also be disrupted (Devine-Wright, 2009). In hydroelectricity proposals, the disruptions can be more critical than others because water bodies (e.g., rivers and lakes) are attractors for settlement as well as many ancillary landscape uses and values, such as recreation, aesthetics, educational use, and spiritual values (Beverly, Uto, Wikes, & Bothwell, 2008). Visually, water landscapes play a role in connecting various landscape features (Menárguez & Holgado, 2014), which can be disrupted by the appearance of a hydroelectric dam (Filova, Vojar, Svobodova, & Sklenicka, 2015; Parkhill, Butler, & Pidgeon, 2013). Culturally, water bodies like rivers, lakes, and oceans were the birthplaces of human civilization, providing appropriate conditions for settlement and trade (Menárguez & Holgado, 2014), evident today by towns scattered along rivers. Socially, water bodies can be the carriers of people's livelihoods and lifestyle, such as in some agricultural regions (Atkins et al., 1998). Thus, changes in water landscapes can cause local stress due to many overlapping meanings and negative effects along multiple dimensions. This also explains why hydroelectric energy facilities are often unwelcomed and stigmatized early on as representing the deterioration of nature, landscapes, and way of life (Parkhill et al., 2013).

Only recently have social and cultural factors been integrated into energy planning processes, despite the multi-dimensional values of affected landscapes. Instead, landscapes have been discussed and assessed with a focus on economic and ecological perspectives. In practice, energy projects that involve landscape changes are often driven by government from an outside expert perspective or proponents who have strong interest in economic benefits (Brown, 2006; Butler, 2016; Vouligny, Domon, & Ruiz, 2009). The expert perspective is one in which the visual and ecological assessment of landscape is done from outside

* Corresponding author at: School for Resource and Environmental Studies, 6100 University Ave, Faculty of Management, Dalhousie University, Halifax, NS, B3H 4R2, Canada.
E-mail addresses: yanchen@dal.ca (Y. Chen), jparkins@ualberta.ca (J.R. Parkins), kate.sherren@dal.ca (K. Sherren).

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the place and without engagement with its residents, and has dominated many methods used since the 1970s (Daniel, 2001; Litton, 1968; Taylor, Zube, & Sell, 1987). Also, the quest for 'social license to operate' by government and project proponents encourages them to elevate economic benefits to balance potential negative effects. For their part, ecologists and environmentalists monitor the potential anthropogenic disturbances in natural environments. It seems to be more difficult to integrate social and cultural dimensions to such processes, although they are necessary to tell the full story (Plottu & Plottu, 2012).

One of the reasons why social values are often ignored in energy proposals is because marketed values 'win out' over non-marketed values when proposals are expected to affect different values or uses in different ways: the less tangible ones can simply be overlooked. This is despite the fact that social and cultural perspectives of landscape values and immaterial benefits of the landscape are increasingly understood to be indispensable in landscape management (Burkhard, Petrosillo, & Costanza, 2010). Marketed values of the landscape can be estimated by indicators such as loss of productive land, real estate values, volume of transportation, development of tourism, employment, and so on (Brown & Weber, 2012). These less tangible values, however, have no associated market prices (e.g., aesthetic enjoyment), which makes it difficult to measure how important a particular value is for an individual or to observe it in market transactions.

Another challenge to integrating social and cultural values is human subjectivity, which makes such values difficult to quantify and assess (Gobster, Nassauer, Daniel, & Fry, 2007; Tenerelli, Demšar, & Luque, 2016), at least in ways that can be directly compared with economic and ecological data. When values vary from person to person and place to place, fragmentation makes those scattered voices easy to dismiss in the collective decision-making process, for instance pejoratively as NIMBYism (Not In My Back Yard) (Brown & Weber, 2012; Devine-Wright, 2009). Subjectivity cannot be avoided in social science, but the various methodological approaches that do exist for cataloguing the issues tend to trade off richness (e.g. qualitative methods) and generalizability (e.g. surveys). Approaches have been applied that seek to map multi-dimensional values, including aesthetic, recreation, life sustaining, learning, spiritual, historic, future, therapeutic, and cultural values alongside the economic and ecological ones (Beverly et al., 2008; Brown, 2006; Brown & Donovan, 2014; Zhu, Pfueller, Whitelaw, & Winter, 2010). Visual quality rating has also been applied to scenic landscape assessments (Palmer & Hoffman, 2001).

A last challenge to incorporating social and cultural values is the bias that can be introduced or simply perceived as a result of research or stakeholder participation. When applying active participation approaches (e.g., survey, interview, etc.) in social science research, it can be difficult to attract the necessary respondents and the high cost per response limits the number of participants (Brown & Weber, 2012). In addition, influence from researchers cannot be avoided when participants only answer the provided questions and may be further affected by interview dynamics (e.g., power, gender, etc.). More importantly, there is often demographic bias in the samples because the younger generations are less actively engaged in public participation (Delli Carpini, 2000; Pasek, Kenski, Romer, & Jamieson, 2006; Sloam, 2012) or research activities (Keilty, Beckley, & Sherren, 2016).

Social media data present new opportunities for mapping landscape values while overcoming some of the challenges mentioned above. It has seen recent use in cultural ecosystem services, planning, and landscape studies (Barry, 2014; de Vries et al., 2013; Martínez Pastur, Peri, Lencinas, García-Llorente, & Martín-López, 2016; Richards & Friess, 2015; Tenerelli et al., 2016; van Zanten et al., 2016). Social media users apply the sites to document their lifestyles and attitudes, which may indicate thus-far hidden information for cultural and social values of the landscape. Mapping landscape values by geo-tagged social media data can expose and aggregate otherwise hidden values held by scattered individuals and thus help integrate lay planning perspectives into expert-orientated processes. Using social media as additional data source can be a good complement to conventional approaches. Social media data have many strengths, such as cost-efficiency for data collection, convenience given precise geographic information for each datum, and reduced researchers' subjectivity because the data do not involve direct contact between researcher and participant. It also shifts if not removing demographic biases. First, it can reveal the preferences of the 'silent majority', rather than the groups with strong preferences and opinions about proposals and thus are more likely to speak up in formal processes. Second, it 'recruits' the younger generations who are hard to attract to research or stakeholder processes (Delli Carpini, 2000; Quintelier & Vissers, 2008; van Zanten et al., 2016).

In this paper, we will use geo-tagged *Instagram* posts, including photos and accompanied captions collected in the two study areas, the degrading Mactaquac Generating Station (Mactaquac), New Brunswick, and the in-progress Site C Clean Energy Project (Site C), British Columbia, to identify and map landscape values. We will probe two questions: (1) if and how social media data from *Instagram* can be used to map landscape values; and (2) what insights and implications such landscape value maps present for the two hydroelectric projects.

2. Mapping landscape values and the use of social media data

In past decades, researchers have integrated social, cultural, historic and other hidden values into landscape value frameworks (Beckley, Stedman, Wallace, & Ambard, 2007; Brown & Reed, 2000; Dakin, 2003; de Vries et al., 2013; Gómez-Sal, Belmontes, & Nicolau, 2003). Vouligny et al. (2009) evaluated landscape from a more comprehensive perspective including 19 attributes, among which detailed dimensions were described, such as sense of home, memories, tranquillity, particularities, and community. Butler (2016) studied various landscape value typologies utilized in previous research and synthesized them into a six-category list: economic, natural significance, aesthetic/scenic, recreation, cultural significance, and intrinsic. Despite comprehensive landscape value typologies like these, it can still be challenging to understand perceived social and cultural values at an individual level. Individuals evaluate landscapes based on personal knowledge and their experience of nearby spaces, communities they foster, assessments of utility, feelings of belonging, established lifestyles, and many other factors (Vouligny et al., 2009; Zube, 1987).

Some researchers are mapping where specific landscape values occur and why (e.g., public participation GIS). This helps reveal place-specific perceptions, attitudes, and preferences among different stakeholders and land use groups (de Vries et al., 2013; Plieninger, Dijks, Oteros-Rozas, & Bieling, 2013), and provide a feasible approach to spatially aggregate individually perceived landscape values, while revealing diversities among people, communities, and places. However, challenges still exist. For instance, in PPGIS challenges include standardizing the scale and precision of capture, as well as respondents being prompted with a specific limited set of values (Brown & Donovan, 2014). Bergeron, Paquette, and Poullaouec-Gonidec (2014) applied on-site and mobile interviews to understand place-specific values, showing the difficulty to eliminate influence from interviewers and the limitation of constructed questions. Sherren, Fischer, and Price (2010) used photo elicitation to catch the spatially-varying values of graziers in New South Wales, Australia. Participants were asked to photograph significant features on their properties and the photos, and their respective viewsheds were mapped to understand attachment to trees. Such approaches are expensive and time-consuming and only feasible for small samples.

To overcome the drawbacks of small sample sizes, self-selection bias (e.g. demographic), cumbersome methods and researcher interference, some researchers make use of data from social media sites. Barry (2014) collected photos from *Flickr*, an online photo-sharing site, to understand public values, interest, and perceptions about cattle grazing on public rangelands. Richards and Friess (2015) retrieved geo-tagged photos