Using GIS to Survey Landscape Values

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1.0 INTRODUCTION

Landscape values are fundamental to a functioning society, and many of these values are location specific or may vary with changing geographical context. Such values include aesthetics, economic, place attachment, and recreation. The surveying of these values is important for understanding place and making environmental decisions. This research demonstrates how public participatory GIS can be used to collect landscape values, which can be combined with the NZ Landscape Character Classification to understand landscape preferences.

New Zealand landscapes are world renowned and central to our national identity, quality of life and tourism industry (Peart, 2004). This research identifies key values people attribute to landscapes in the Otago and Southland DOC Conservancies, by using a method that combines the internet and GIS. This new method enhances landscape suitability analysis and provides substantive perception information to inform debates on future land use.

There are many layers that contribute to the physical character of landscapes, including landform, water, land-cover, and infrastructure. Likewise there are many dimensions to how people perceive landscapes, which include culture, place attachments, identity and aesthetics (Peart, 2004). When proposed land uses generate significant controversy, such as proposals for wind farms or infrastructure developments, obtaining knowledge about landscape values to inform these debates is always difficult because landscape involves both the physical landscape and human perception. Psychophysical analysis is generally deemed the most theoretically valid method for landscape assessment (Daniel and Vining 1983), and typically this has involved asking people to rank landscape photos. The main problems with this method are the cost, small sample sizes (typically < 100) and the inadequacy of single photographs as a representation of a landscape. Consequently, the traditional psychophysical approach has proven insufficient in providing adequate empirical findings to reliably identify key landscape values and to inform land use decisions.

2.0 NEW ZEALAND LANDSCAPE CLASSIFICATION

This study uses the NZ Landscape Classification (NZLC) developed by Brabyn (1996) and subsequently updated (Brabyn, 2009). The NZLC is a classification of character, not quality, and is built from the unique combinations (spatial overlays) of six landscape components—landform, landcover, infrastructure, water, dominant landcover, and water views. The purpose of landscape classification is to provide a frame of reference for communicating landscape research, just as a plant classification improves communication for botanists. The classification system uses common language to describe the landscape components and component categories. The six landscape components have the potential to produce many thousands of landscape classes—unique combination of components—which may be impractical for some applications.

3.0 PPGIS DATA COLLECTION

There has been considerable research in the last decade to identify landscape values using participatory GIS methods to inform national parks and protected area management (Brown & Weber, 2011), residential and tourism development (Brown, 2006; Raymond & Brown, 2007), and coastal area management (Alessa, Kliskey, & Brown, 2008).

PPGIS websites for each of the regions were developed after consultation and pilot testing with DOC staff. PPGIS data collection consisted of two parts; (a) spatial attribute mapping using a custom Google® maps application, and (b) general survey questions assessing participants' familiarity with conservation areas in the region and selected socio-demographic information. A total of 608 participants were recruited January through March 2011through a random mail sample of households in the Southland and Otago regions, by visitor contact at conservation areas, and by advertising in media outlets such as local newspapers.

The spatial attributes to be identified by participants included the following landscape values: scenic/aesthetic, recreation, economic, ecological, social, historical, and wilderness. Participants were instructed to drag and drop markers representing these values to the appropriate location on a Google® base map. The map showed the shaded relief and standard topographical detail so that participants could accurately locate particular places. PPGIS mapping precision by participants was enforced by only allowing the placement of markers if the participant had zoomed-in to a predetermined zoom level (Level 12) in Google® Maps (approximately 1:100,000 scale).

4.0. DATA ANALYSIS

To prepare the spatial data for analysis, we intersected the seven PPGIS landscape values with the six NZLC landscape components (landform, landcover, dominant landcover, water, water view, and infrastructure) and the NZLC landscape classes, which are combinations of the six landscape components. This produces a large table consisting of all the points collected, the landscape value associated with the point, the categories for each of the six landscape components, and the landscape class. This data was analysed using frequency counts, and residual analysis.

Frequency counts involved summing the numbers of landscape values falling within each landscape component and landscape class. This identifies the most popular landscape components and classes associated with different landscape values. However, simple frequencies can be misleading when landscape classes are disproportionately over or under-represented in the study region. If a landscape class is uncommon but has many landscape values, or if a landscape class is abundant but does not have high value counts, these findings merit attention. To account for proportional differences in landscape classes, residual analysis is used.

Residuals analysis involved calculating the total area (ha) and the percentage area of the study site for each landscape component category. The landscape value counts, expressed as a percentage of the total count, were compared with the percentage area of the landscape to produce standardized residuals. Residuals analysis provides useful information by indicating which landscape values are significantly over or under-represented in the different landscape categories. A residual is defined as the difference in the observed frequency and the expected frequency. A standardized residual is calculated by dividing the residual value by the standard error of the residual. Standardized residuals are a normalized score like a z score without units and if greater than 2.0, indicate significantly more landscape values than would be expected given the size of the area, while standardized residuals less than -2.0 indicate fewer landscape values based on the size the area. Standardized residuals provide an indicator of over- or under-representation of landscape values, but cautious interpretation is warranted because expected counts are based on landscape component areal proportions. Because PPGIS participants do not randomly locate landscape values, there is not an a priori expectation that the landscape values be distributed by areal proportionality. We included analysis of standardised residuals to account for the possibility of distributional bias based on landscape component area within the study region.

5.0 RESULTS

The method used in this study has produced results that are plausible and consistent with previous landscape perception studies in New Zealand. In addition, the scale of this study exceeds other landscape perception studies in NZ; we analysed 8,824 landscape value points from 608 participants providing information on 2,761 unique landscape classes. This is a large number of participants compared to traditional landscape perception studies in NZ. For example Fairweather and Swaffield (1999) study of perceptions in the Coromandel region had 88 participants. The results indicate that the general public associate particular values with specific landscape components at a regional scale. Greater than expected landscape values were associated with urban areas, water features, indigenous landcover, and mountains. Fewer than expected landscape values were associated with flatter, agricultural landscapes. The method demonstrated the capacity to assess small landscapes features, such as islands and ski lifts, as well as large mountainous landscapes. Our analysis confirmed previous studies indicating human preferences for landscapes with natural features, mountains, and water. Our analysis also revealed more subtle landscape relationships not previously published. From the top 25 landscapes classes valued water in the form of lakes, estuaries, and views of the ocean and enclosed sea appear most frequently (8 times). Water is a known landscape attraction and this study confirms the importance of water in the landscape. Water is valued in a range of landcover and landform contexts, even in agricultural areas with low topography. Mountainous areas, particularly high mountains with glaciers and alpine tussock are also highly valued (e.g., 14 of the top 25 landscapes include mountains and high plateaus). Many of these landscape classes are dominated by indigenous vegetation. These findings are consistent with previous landscape perception studies dating back to the 1800s and early 1900s that describe the high country as picturesque and sublime (Nightingale and Dingwall, 2003). Swaffield and Foster's (2000) review of South Island's (NZ) high country found that low intensity farming (low producing grassland) in the mountains provides iconic landscape views. Our results show moderate landscape values associated with developed grassland (6 out of 25) even with low topography and without water. This finding has not been substantiated in previous studies in NZ but should not appear surprising. People enjoy the vernacular landscape, perhaps because they are common and easily accessible.

6.0 CONCLUSION

The combination of PPGIS data with a landscape classification system provides a powerful, alternative for landscape assessment compared to traditional psychophysical landscape assessments that use photos. The method described herein provides an efficient method for assessing landscapes at the regional scale and could be replicated in other regions or countries that have a landscape classification system. The use of classification systems is common in the natural sciences because these systems provide an important frame of reference for communication, and yet, their adoption in the social sciences has lagged. Without the NZLC, our detailed examination of the relationships between landscape values and physical landscapes would not have been possible. To advance landscape research, the development of landscape character classification systems appears essential.

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