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Mapping and measuring place attachment

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ABSTRACT

The concept of place attachment has been studied extensively across multiple disciplines but only recently with empirical measurement using public participation GIS (PPGIS) and related crowd-sourcing mapping methods. This research trialed a spatially explicit method for identifying place attachment in a regional study in South Australia. Our research objectives were to (1) analyze and present the spatial results of the mapping method as a benchmark for future research, (2) compare mapped place attachment to the more common practice of mapping landscape values in PPGIS that comprise a *values home range*, (3) identify how participant socio-demographic and home location attributes influence place attachment, (4) provide some guidance for mapping place attachment in future research. We found large spatial variability in individual place attachment and mapped landscape values using both area and distance-based measures. The area of place attachment is influenced by occupational roles such as farming or conservation, as well as home location, especially in coastal versus non-coastal contexts. The spatial distribution of mapped landscape values or *values home range* is related to, but not identical to mapped place attachment with just over half of landscape values located outside the area of mapped place attachment. Economic livelihood values, as an indicator of place dependence, and social values, as an indicator of place identity, are more likely to be mapped within the place attachment area. Aggregated place attachment across participants in the region showed similar spatial intensity to aggregated *values home range*, but area-based assessment of place attachment and values home range are distorted by edge effects such as a coastline. To further develop the mapping of place attachment in PPGIS, we identify knowledge gaps from our study and offer suggestions for future research design.

Introduction

The place attachment concept focuses on how strongly people feel a sense of connection to a particular place and captures the distinction between the goods and services provided by that place and the emotional and symbolic relationships people form with place (Williams, Stewart, & Kruger, 2013). These connections can be positive or negative, depending upon one's experience in place (Manzo, 2005). However, conceptualizations of place attachment vary depending upon the whether scholars focus on the personal, environmental, and/or social context of people-place interactions (Raymond, Brown, & Weber, 2010). Multiple studies have emphasized the personal context, particularly the emotional and physical/functional bonds which develop between an individual and a geographic locale (Bricker & Kerstetter, 2000; Gunderson, 2006; Moore & Graefe, 1994; Williams, Patterson, Roggenbuck, & Watson, 1992). Other studies have emphasized the connections developed between multiple people in place (social context), including dimensions related to community place attachment, social bonding, belongingness, and familiarity with one's neighborhood or social group (Christensen & Burchfield, 2013; Hammitt, Backlund, & Bixler, 2004; Kyle, Graefe, & Manning, 2005; Mihaylov & Perkins, 2014; Perkins & Long, 2002; Trentelman, 2009). A third strand has emphasized how aspects of the physical setting (particularly the natural setting) shape place bonds, reflected in the related constructs of environmental identity, connectedness to nature, and nature bonding (Brügger, Kaiser, & Roczen, 2011; Mayer & Frantz, 2004; Raymond et al., 2010; Schultz, Shriver, Tabanico, & Khazian, 2004).

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Additionally, multiple research methods have been used to operationalize place attachment, each with different theoretical or epistemological viewpoints (Manzo & Devine-Wright, 2014). For example, by drawing on phenomenological roots, Seamon (2014) encourages a dynamic understanding of people-place connections rather than a static, quantitative interpretation of the intensity of place bonds. Masso, Dixon and Durrheim (2014) discuss a discursive perspective on human–environment relations, focusing on the processes through which place attachments form. Place bonds are constructed through the interaction of individuals and structures in a socio-institutional context. From a positivistic perspective, scholars have developed a variety of self-report instruments to assess the structure and intensity of place bonds (Hammitt, Kyle, & Oh, 2009; Kyle et al., 2005; Raymond et al., 2010; Williams & Vaske, 2003). Two dimensions of place identity and place dependence have been regularly identified. Place identity refers to those dimensions of self, such as the mixture of feelings about specific physical settings and symbolic connections to place that define who we are. Place dependence refers to the functional or goal-directed connections to a setting; for example, it reflects the degree to which the physical setting provides conditions to support an intended use (Schreyer, Jacob, & White, 1981).

Recent commentaries encourage a critical pluralist perspective to place attachment to acknowledge the diversity of ways in which it has been conceptualized and measured. This perspective holds that no one research theory or program by itself can successfully engage the various facets of place inquiry (Patterson & Williams, 2005; Williams, 2013; Williams, 2014). Meanings of place can be grounded in different epistemological assumptions ranging from the adaptive to the constructed; and epistemological assumptions ranging from the generalizable to the contextual (Williams, 2014).

However, an important spatial component is missing from current pluralistic perspectives. Exploratory studies indicate that place attachments develop to different intensities within different spatial scales such as house, neighborhood, and city (Hidalgo & Hernández, 2001); and that some forms of place attachment are localized whereas others are generalized across a whole region (Lin & Lockwood, 2014). Despite the identification of these spatial differences, few techniques exist for assessing the extent to which place attachments are spatially localized or generalized (Lin & Lockwood, 2014). Brown and Raymond (2007) examined whether non-spatial psychometric measures of place attachment were related to the identification and mapping of place-based values and special places using public participation GIS (PPGIS) methods. They found a relatively small, but statistically significant amount of the variance in place identity and place dependence was explained by the spatial attributes participants mapped, thus concluding that PPGIS mapping of values and special places is related to the scale-based, psychometric measures of place attachment, but with the added benefit of providing place-specific information for land use planning (Brown & Raymond, 2007, p. 89). But the Brown and Raymond (2007) study did not specifically operationalize and measure the spatial delineation of individual place attachment and how the spatial delineation may be related to participant characteristics and other spatial variables identified in the PPGIS process. Cacciapaglia and Yung (2013) adapted a participatory mapping technique to spatially identify place meanings and their relationships to fire and fuel planning. The mapping activity enabled landowners to mark important places on a map and describe why those places were important. Landowners could make multiple maps, identifying locations important for different reasons. However, the spatial associations between the place meanings and specific types of place attachments or values were not considered.

Place attachment and "home range"

In this study, we operationalize and evaluate a method to spatially identify individual place attachment in a regional PPGIS study in South Australia. Consistent with a common definition of place attachment, study participants were asked to identify the boundaries of an area that they most strongly identify with and/or depend on for their lifestyle and livelihood. We posit that what is termed "place attachment" has much in common with what biologists call a "home range". In a classic paper, Burt (1943) describes a biological home range as the "area traversed by the individual in its normal activities of food gathering, mating, and caring for young." Some might resist attribution of the home range concept to humans given evolution has significantly expanded the range of human behaviors undertaken to fulfill both material and non-material needs. And for some individuals, non-material needs appear considerably more influential than material needs in determining the location and extent of home range. And yet, the core idea of a home range consisting of a spatial area containing needed resources (material and non-material) still appears applicable to humans, subject to large spatial and temporal variability.

Powell and Mitchell (2012) analyze the concept of biological home range using the recorded behavior of a human subject and propose that a home range is the interplay between the physical environment and the understanding of the environment which they term a "cognitive map." A cognitive map is kept up-to-date with the status of resources and places to go to meet needs. The places and areas that an animal can "visualize" become part of the home range where visualization means to have a mental concept of place. A home range consists of layers of different "currencies" such as food, energy sources, and income that vary in importance depending on the animal's physical and mental condition. Although an animal can visit locations temporarily outside the home range, Powell and Mitchell (2012) suggest the best concept of home range "is that part of an animal's cognitive map of its environment that it chooses to keep updated" (p. 948). Home ranges change and adjust over time consistent with changes in behavior and can include areas that are known but not necessarily visited frequently.

We propose that the PPGIS mapping of landscape values represents a spatially explicit method that reveals a cognitive map of an area and thus forms at least part of what we call a *values home range*. Further, the spatial attributes that are requested to be mapped in PPGIS represent different "currencies" (places of importance) that form part of the home range. We hypothesize that the mapping of place attachment as operationalized in this study is related to the concept of a home range as identified through the spatial mapping of landscape values. Our spatial measure of place attachment included a symbolic component of place identity and a functional component of place dependence. Place identity refers to those dimensions of self, such as the mixture of feelings about specific physical settings and symbolic connections to place that define who we are (Proshansky, Fabian, Kaminoff, Library, & Raymond, 1983). Place dependence refers to the ability of a place to satisfy needs and goals, or the extent to which the physical characteristics of the place provide the appropriate resources for one's preferred activities, along with frequent use of the place (Stokols & Shumaker, 1981). It is therefore plausible that place attachment reflects both a social identity, and like home range, an area in which one meets functional needs. We further posit that place attachment represents an area of home range that is more influenced by those landscape values that promote economic livelihood and social identity (see Fig. 1).

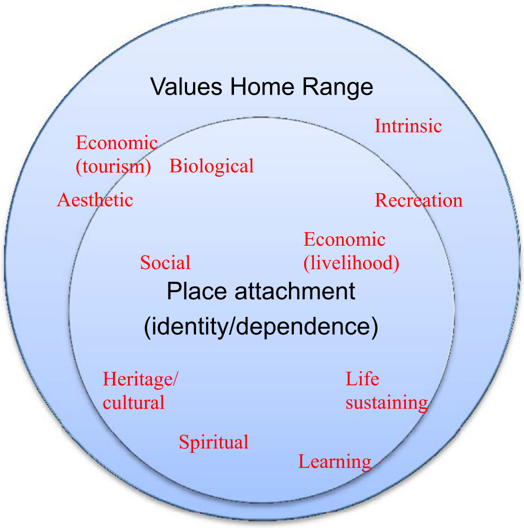

Fig. 1. Place attachment is posited to form part of a *values home range* representing a cognitive map of human space. Individual values reflect different currencies or levels of importance to an individual and are dynamic with respect to time and location.

Mapped landscape values as a "home range"

The identification and mapping of landscape values, alternatively called social values for ecosystem services (Sherrouse, Clement, & Semmens, 2011), has been the subject of multiple PPGIS studies (see Brown & Fagerholm, 2014; Brown & Kyttä, 2014; for recent reviews) but have yet to be linked with the biological concept of "home range" or to be compared to a direct spatial measure of place attachment. Landscape value mapping has been implemented in a wide range of environmental and land use planning applications (Brown, 2005). Mapped landscape values are spatially related to physical landscape features such as land cover (Brown, 2013a), are influenced by the home location of participants (Brown, Reed, & Harris, 2002), are relatively stable when measured over time (Brown and Weber, 2010; Brown and Donovan, 2014), are influenced by participant knowledge familiarity of the region (Brown and Reed, 2009), are related to non-spatial values and preferences (Brown, 2013b) and environmental worldviews (Van Riper and Kyle, 2014), and are sensitive to the potential for sampling bias (Brown, Kelly, and Whitall, 2014).

The mapping of landscape values in PPGIS is posited to reveal a spatial cognitive map wherein landscape values reflect different "currencies" or metrics for examining home range based on point locations. Within the biological literature, various methods have been used to estimate home range (see Powell, 2000, for a summary of methods). One common method is to use the minimum bounded area of all animal locations termed the minimum convex polygon (MCP). When applied to landscape values, we call this a "values home range" to emphasize the spatial cognitive map of the individual rather than the spatial intensity of use inferred from locational data.

In this article, we compare the spatial similarities and differences between a values home range with the direct mapping of place attachment using an area based-assessment (minimum convex polygon). Although the MCP method has been widely applied to estimate biological home range for various species, the method tends to significantly overestimate the use of an area (Burgman & Fox, 2003) and can fail to distinguish between the importance of different home range currencies that contribute to the home range estimate (Powell & Mitchell, 2012). We speculate that a values home range or cognitive map is more complex and nuanced than can be expressed in a simple bounding geometry of area, thus we also examine the spatial distribution of landscape values using a distance-based approach—measuring distance from domicile to mapped landscape value locations.

Our research was guided by the following questions: (1) When place attachment is directly identified in PPGIS using a bounding area approach, what is the spatial variability of participant response and how is the resulting area related (or not) to participant characteristics such as age, length of residence, occupation, and domicile? (2) What is the spatial relationship between the measurement of place attachment and a *values home range* identified from the distribution of mapped landscape values? (3) What relationships exist between the spatial distribution of mapped landscape values, domicile, and characteristics of other participants? In the absence of previous research on this topic, we use multiple spatial methods to answer these questions consisting of both area and distance-based measures.

Methods

Study location

The South East Natural Resources Management Region (SE Region) is located in the South East of South Australia and is bounded by the Victorian border to the east, the Southern Ocean to the south and west and rangeland areas to the north (Fig. 2). It extends over an area of 28,000 square kilometres and supports a population of over 64,000 people (SE NRM Board 2010). The main city of Mount Gambier, located in the southern tip of the region, is the second largest urban centre in South Australia and has a population of over 27,000 people. Other larger towns include Naracoorte, Millicent, Bordertown, Kingston and Keith. Robe, Beachport, Port MacDonnell and Penola are popular holiday destinations. In 2010–2012, the Limestone Coast attracted 553,000 visits, comprising 509,000 domestic visitors and 44,000 international visitors. The majority of people visited the region for holiday reasons (52%), followed by visiting friends and relatives (28%), and business (15%) (South Australian Tourism Commission, 2012). Agriculture, forestry, and the fishing industry are significant land-uses in the SE Region, accounting for 20% of direct employment (SE NRM Board, 2010). Timber, wine and potato processing industries are also economically important to the region. Only 13% of native vegetation cover remains across the region and includes diverse habitat types such as woodlands and forests, grassy woodlands, dry heathlands and mallee, scattered trees, open water swamps and wetlands and rising springs (SE NRM Board, 2010).

Sampling technique

The project team engaged communities of place (e.g., landholders), communities of interest (e.g., forestry, agriculture, conservation groups), and a crowd-sourced sample of the general public to ensure that a wide diversity of values, attitudes and preferences were collated (Auricht, Raymond, Thackway, & Imgraben, 2014). Each survey had a unique access code that enabled individuals in these sub-groups to be identified.

Landholders

We used stratified, random sampling techniques to generate a representative sample of 2, 400 landholders from the South East cadastral database (property file). We selected landholders in each stratum using the following logic:

1) Urban landholders – landholders owing less than 2 ha of land in the SE region (n = 800);

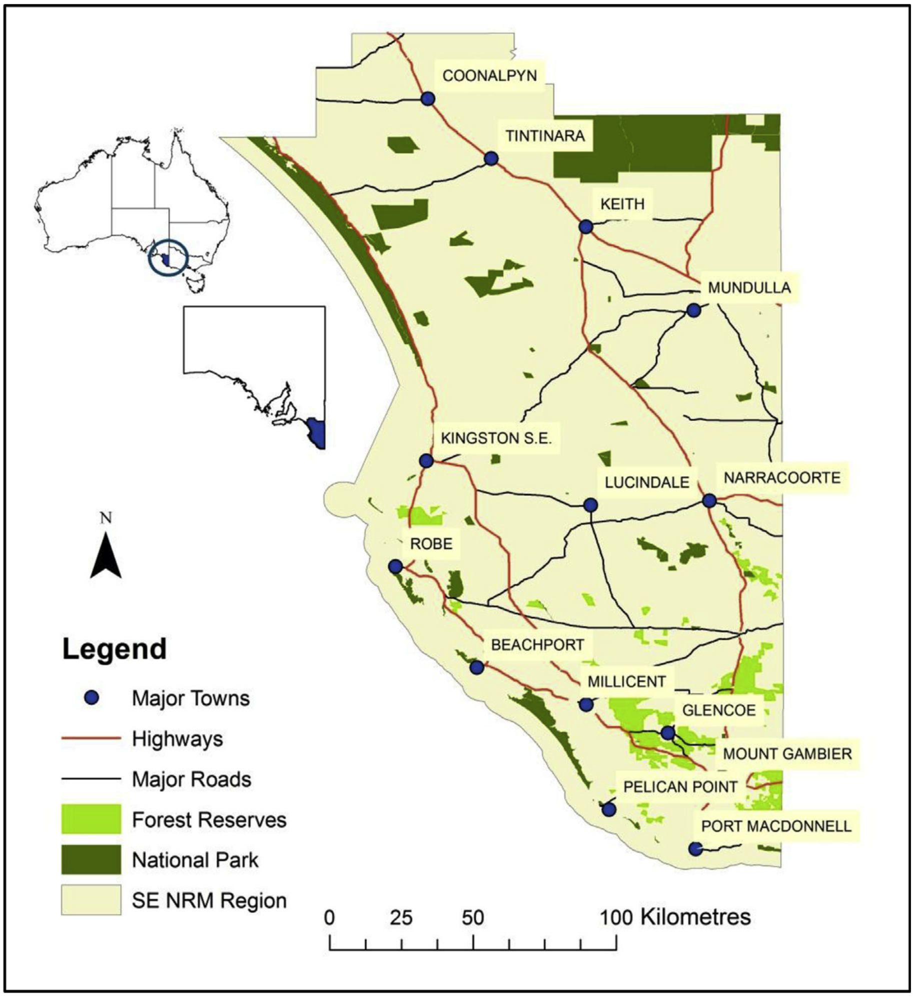

Fig. 2. Map of the study area—South East Natural Resources Management Region, South Australia.

2) Peri-urban landholders – landholders owning greater than two but less than 20 ha of land in the SE region (n = 800), and;
3) Rural landholders – landholders owning greater than 20 ha of land in the SE region (n = 800).

Each urban, peri-urban, and rural landholder was sent a letter inviting them to participate. The invitation included a link to the online survey and a unique access code. A participant information sheet was also included with the letter that outlined the purpose and scope of the project. We received 188 non-deliverable returns in the mail, resulting in an effective sampling frame of 2212 landholders.

Communities of interest

We asked the South East NRM Board to generate a list of industry sectors that had an interest in NRM in the region. We received a list of 70 groups for potential participation. The CEO/Chair/Secretary of each group was sent an invitation letter and information sheet, as well as 10 access codes for distribution. He/she was asked to distribute the access codes and URL to the online survey to 10 members or staff of the group. The Communities of Interest sampling group participated in the survey at the same time as the landholder sample.

Volunteer public

To encourage the general public to participate (i.e., those not specifically invited via letter), the online survey was advertised on ABC regional radio, as well as via the NRM Board's website and newsletter. We asked this crowd-sourced sample to go to the survey website and 'request an access code'. This volunteer public was assigned a randomly generated access code that was distinct from the communities of interest and landholder samples.

Measurement of key variables

Socio-demographic and property characteristics

The online survey asked participants to report their age, gender, highest level of formal education, occupation, and industry sector. Additionally, respondents were asked whether or not they were a resident of the South East region, and if so, their length of residence. They were also asked to rate their level of knowledge of places in the region.

Landscape values

Twelve pre-defined landscape values and a special place marker were included in the online survey (Table 1). The website can be viewed at http://www.landscapemap2.org/southeast (use access code 101-0101). Survey participants were asked to

Table 1
Attributes and operational definitions provided to PPGIS study participants.

Icon	Attribute	Operational definition
	Place of residence	Your home – Identify your main place of residence in the South East. Your responses will be kept confidential. Please skip if your residence is not in the South East.
	Your "Place"	Place 3 or more markers to show the outer boundaries of the area in the South East region you most strongly identify with and/or depend on for your lifestyle and livelihood. Please identify only one area.
	Aesthetic	These places are valuable because they have attractive or pleasing landscapes.
	Recreation	These places are valuable because they provide recreation opportunities.
	Biological	These places are valuable because they provide for a variety of plants, wildlife, or marine life.
	Economic (agriculture)	These places are valuable because they provide for food, fiber or the raising of animals.
	Economic (tourism)	These places are valuable because they provide places that support local businesses.
	Life Sustaining	These places are valuable because they provide surface or groundwater, help produce clean air and fertile soil, or provide materials from nature that sustain us.
	Heritage/cultural	These places are valuable because they represent history or provide opportunities to express and appreciate culture or cultural practices such as art, music, history and Indigenous traditions.
	Learning/research	These places are valuable because they provide places where we can learn about land management through observation or study.
	Social	These places are valuable because they provide opportunities for social interaction or provide places for community services such as schools, sporting clubs, and hospitals.
	Intrinsic/existence	These areas are valuable in their own right, no matter what I or others think about them.
	Spiritual	These places are valuable because they are sacred, religious, or spiritually special places or because I feel reverence and respect for nature here.
	Other special places	These places are special or valuable because … please indicate your reason.

identify places on the map associated with each value type and then drag and drop value markers onto the map location. Participants could identify as many locations as they wanted on the map for each value type. The x and y coordinates and the descriptor for each mapped landscape were stored in a web server database and downloaded for analysis at the end of the data collection period.

Place attachment

Individuals were requested to identify the outer boundaries of an area in the study region that *they most strongly identify with and/or depend on for their lifestyle and livelihood*. This definition is consistent with the place identity and place dependence conceptualization of place attachment used in previous studies (e.g., Williams & Vaske, 2003). Participants were only allowed to identify one place attachment area. A total of 259 individuals identified their place attachment area requiring the placement of a minimum of three bounding points. The following instructions were provided to participants:

"Place 3 or more markers to show the outer boundaries of the area in the South East region you most strongly identify with and/or depend on for your lifestyle and livelihood. Please identify *only one* polygon area."

Spatial data preparation

The spatial data was prepared by clipping all mapped points to within a 50 km buffer of the study area. Minimum convex polygons (MCPs) for place attachment were generated for all participants that included the participant's home location and the required minimum three bounding points ($n = 259$). The same procedure was followed to generate MCPs for areas containing landscape values with a minimum of three mapped values per participant ($n = 337$). To help visualize the spatial analyses performed, Fig. 3 shows a study participant's home (domicile), mapped place attachment MCP, and the MCP for all landscape values identified by the participant. To perform distance analysis, vectors were generated and measured using Euclidean distance from the participant's domicile to each mapped landscape value. The participant's domicile was classified as "coastal" if it was located within 20 km of the coast.

Area-based analyses

The MCP areas for both place and landscape values were calculated in GIS and frequency distributions were generated based on area. For each participant, the difference in MCP area (+ or −) was calculated as well as the percentage of value points that fell within the place area polygon. In some cases, the place attachment MCP was larger while in other cases, the values area was larger. The MCP areas for all participants were spatially intersected to generate counts and locations of overlapping polygons. This produced maps of the region showing place attachment areas most common to participants as well as areas with the highest landscape value intensity.

As an alternative to the polygon method, aggregated landscape value densities were generated using kernel density estimates using a one km cell size and a five km bandwidth. Isopleths of the kernel density probability surface were generated to capture 50, 60, 70, 80, 90, and 95 percent of the cells using the Geospatial Modeling Environment (Beyer, 2014). The aggregated polygon maps and kernel density maps were visually compared to identify similarities and differences in these two alternative methods for assessing the spatial intensity of landscape values.

Relationships between participant characteristics and the MCPs for place attachment and landscape values where examined using statistical analysis. Pearson's correlation coefficients were calculated between MCP area and participant age and years of residence in the region, t-tests were used to examine potential differences in size of area mapped based on participant gender and domicile (coastal/non-coastal), and one-way ANOVA was used to examine whether the size of mapped areas were significantly different based on sampling group, occupation, and job sector.

Distance-based analyses

The Euclidean distance between participant domicile and each mapped landscape value was summed and averaged for each type of landscape value, and for all values mapped by a participant. Similar to the area-based analysis, the mean distances were analyzed against participant variables.

Results

Participant response and profile

Overall, 449 residents participated in the PPGIS mapping activity (placed one or more markers) and 309 residents participated

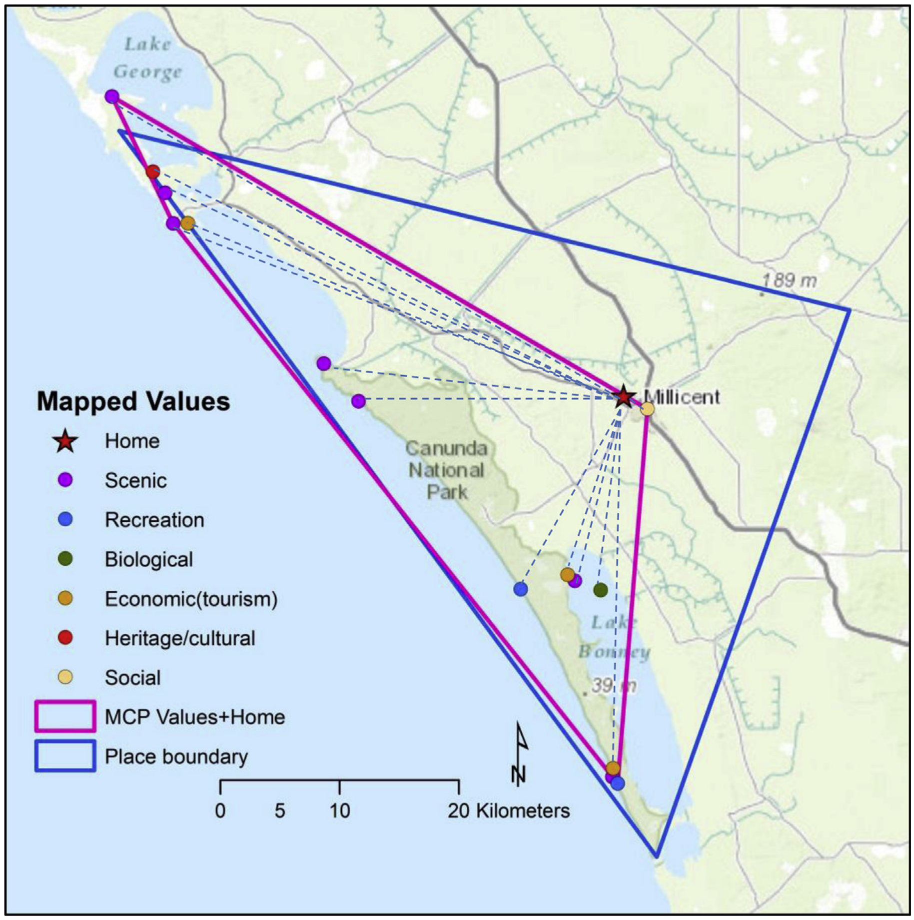

Fig. 3. Map of a single study participant showing a place attachment boundary (blue), landscape values mapped, and a "values home range" operationalized as the minimum convex polygon (MCP) containing mapped values and home location. Figure also shows distance vectors generated from home location to each landscape value that were used in distance-based analyses. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

in both the mapping activity and survey questions. The estimated response rate was between 17.5% and 20%.[1] Study participants had a median age of 55 and had lived in the Southeast region for an average of 36 years. Participants contained more males (69%) than females, and 42% of participants reported completing a tertiary or postgraduate degree in their formal education. About 77% of participants self-rated their knowledge of the region as "good" or "excellent" with only one participant rating knowledge as "poor". The largest proportion of respondents represented agriculture (29.9%), conservation (7.7%) and government (7.4%) livelihoods. Some participants either did not complete the livelihood question (10.0%) or indicated an 'other' livelihood (9.6%). Sampling groups comprised the following percentage of participants: urban (18%), peri-urban (18%), rural (22%), communities of interest (19%); NRM affiliated (8%), and volunteer (15%).

Place attachment

Individuals were requested to identify the outer boundaries of an area within the study region that *they most strongly identify with and/or depend on for their lifestyle and livelihood*. A total of 259 individuals identified their place attachment area following the instructions that required placement of a minimum of three boundary points. The results indicated large variability in the size of the area identified by participants (see Fig. 4). A small number of participants ($n = 2$) identified their place as the entire study region

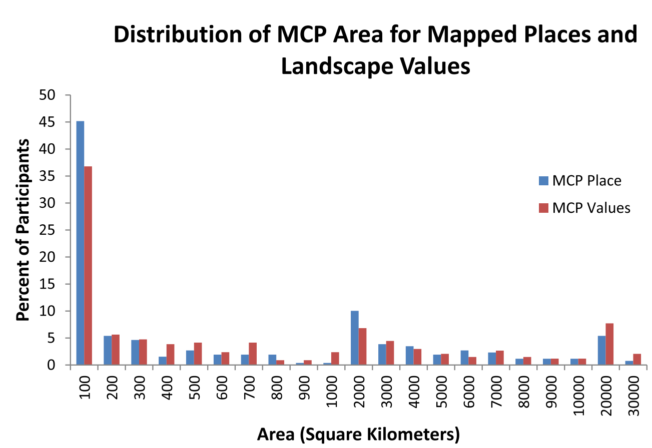

Fig. 4. Frequency distribution of minimum convex polygon (MCP) areas for mapped places and landscape values.

[1] Responses were tracked by assigned web access codes. Invited participants could request and receive access to the study website without using the access codes provided to them. It is possible that some individuals categorized in the volunteer sampling group could be invited participants. Hence, we provide a low and high estimate of response rate.

Table 2
Relationship between participant characteristics and "place", "value" MCP areas, and mean distance (linear) from domicile to values.

	MCP place	MCP Values	Mean distance from domicile to Values	Explanatory notes
Age	No relationship	Weak, inverse relationship (r = −0.15, p ≤ .05).	Weak, inverse relationship (r = −0.16, p ≤ .05).	Significant inverse relationship between age and number of recreation and biological value markers.
Years lived in region	No relationship	Weak, inverse relationship (r = −0.15, p ≤ .05).	Weak, inverse relationship (r = −0.17, p ≤ .05).	Significant inverse relationship between length of residence and total values, biological, aesthetic, recreation, and spiritual values.
Self-identified familiarity	No relationship	No relationship	Weak, positive correlation (r = 0.15, p ≤ .05)	Familiarity variable lacks sufficient variability for meaningful assessment with most participants having "good" or "excellent" knowledge of region
Gender	No relationship	Males $\bar{x}$ = 2444 km^2 Females $\bar{x}$ = 3971 km^2 Statistically different (t = −2.04, p ≤ .05).	Males $\bar{x}$ = 23.2 km Females $\bar{x}$ = 31.6 km Statistically different (t = −2.3, p ≤ .05).	No significant difference in the total number or type of value markers placed.
Occupation (3 groups) *Farming* *Professionals* *Other occupations (combined)*	*Farming* (n = 53) 518 km^2 *Professional* (n = 45) 3103 km^2 *Other*(n = 111) 2287 km^2 Significant different pairs (ANOVA, LSD, p ≤ .05) *Farming/Professional* *Farming/Other*	Farming (n = 61) 1969 km^2 Professional (n = 53) 5361 km^2 Other (n = 152) 2566 km^2 Significant different pairs (ANOVA, LSD, p ≤ .05) *Farming/Professional* *Professional/Other*	*Farming* (n = 54) 18.5 km *Professional* (n = 44) 37.2 km *Other*(n = 116) 25.3 km Significant different pairs (ANOVA, LSD, p ≤ .05) *Farming/Professional* *Professional/Other*	*Professionals* placed significantly more value markers than *farmers* including aesthetic, recreation, biological, and economic (tourism) markers. Farmers placed more economic (agriculture) markers although difference was not statistically significant.
Job Sector (5 groups) *Agriculture* *Conservation* *Education* *Government* *Manufacturing*	*Agriculture* (n = 67) 1152 km^2 *Conservation* (n = 17) 3807 km^2 *Education*(n = 15) 901 km^2 *Government* (n = 17) 1996 km^2 *Manufacturing* (n = 12) 3462 km^2 Significant different pairs (ANOVA, LSD, p ≤ .05) *Agriculture/Conservation* *Agriculture/Education* *Education/Conservation*	*Agriculture* (n = 79) 2055 km^2 *Conservation* (n = 22) 7599 km^2 *Education* (n = 18) 428 km^2 *Government (n=*22) 4286 km^2 *Manufacturing (n* = 17) 3237 km^2 Significant different pairs (ANOVA, LSD, p ≤ .05) *Conservation/Agriculture* *Conservation/Education* *Conservation/Government* *Conservation/Manufacturing* *Education/Government*	*Agriculture* (n = 69) 18.9 km *Conservation* (n = 17) 46.9 km *Education*(n = 14)15.1 km *Government* (n = 18) 32.6 km *Manufacturing* (n = 12) 34.1 km Significant different pairs (ANOVA, LSD, p ≤ .05) *Agriculture/Conservation* *Agriculture/Government* *Agriculture/Manufacturing* *Education/Conservation* *Education/Government* *Education/Manufacturing*	*Conservation* and *government* sectors placed significantly more value markers including many more biological markers. *Agriculture* sector placed significantly more *economic* (agriculture) markers than *conservation* sector.
Sampling Group (6 groups) *Urban* *Peri-urban* *Rural* *Communities of interest* *NRM affiliated* *Other/volunteer*	*Urban*(n = 45) 1925 km^2 *Peri-urban*(n = 43) 3162 km^2 *Rural*(n = 59) 418 km^2 *Communities interest* (n = 54) 2221 km^2 *NRM affiliated* (n = 26) 3207 km^2 *Other/volunteer* (n = 32) 2600 km^2 Significantly different pairs (ANOVA, LSD, p ≤ .05) *Rural/Peri-urban* *Rural/Communities interest* *Rural/NRM affiliated* *Rural/Other/volunteer*	*Urban*(n = 66) 1583 km^2 *Peri-urban*(n = 59) 2098 km^2 *Rural*(n = 69) 1143 km^2 *Communities interest* (n = 68) 3080 km^2 *NRM affiliated*(n = 31) 7685 km^2 *Other/volunteer*(n = 44) 2909 km^2 Significantly different pairs (ANOVA, LSD, p ≤ .05) *NRM affiliated/Urban* *NRM affiliated/Peri-urban* *NRM affiliated/Rural* *NRM affiliated/Communities interest* *NRM affiliated/Other* *Rural/Communities of interest* *Rural/Other*	*Urban*(n = 45) 20.5 km *Peri-urban*(n = 43)27.2 km *Rural*(n = 63)16.1 km *Communities interest* (n = 57) 27.1 km *NRM affiliated* (n = 27) 48.4 km *Other/volunteer* (n = 30) 31.0 km Significantly different pairs (ANOVA, LSD, p ≤ .05) *Urban/NRM affiliated* *Peri-urban/NRM affiliated* *Rural/NRM affiliated* *Communities interest/NRM affiliated* *Other-volunteer/NRM affiliated* *Rural/Peri-urban* *Rural/Communities of interest* *Rural/Other-volunteer*	*NRM affiliated* group identified significantly more values in every category than all other groups, with largest difference in biological values. *Rural* residents placed the fewest number of value markers.
Domicile Location *Coastal vs. non-coastal*	*Coastal (n = 85)*1297 km^2 *Non-coastal (n = 156)* 2428 km^2 Statistically different (t = 2.6, p ≤ .05)	*Coastal (n = 85)*2866 km^2 *Non-coastal (n = 156)* 3322 km^2 No statistical difference (t = 0.65, p > .05)	*Coastal (n = 85)* 22.3 km *Non-coastal (n = 156)* 29.4 km *Statistically different (t = 2.0, p ≤ .05)*	

(about 30,000 km^2) while 27 participants identified their place as less than a square kilometer. About 45% of participants identified places smaller than 100 km^2. Farmers and rural residents identified significantly smaller place areas on average than other sampling groups while participants that identified with a conservation profession mapped significantly larger places (see Table 2). Age, length of residence, and gender were not significantly related to the area of place mapped. Coastal residents identified a significantly smaller area ($\bar{x}$=1297 km^2) than non-coastal residents ($\bar{x}$=2428 km^2, t = 2.6, p ≤ .05).

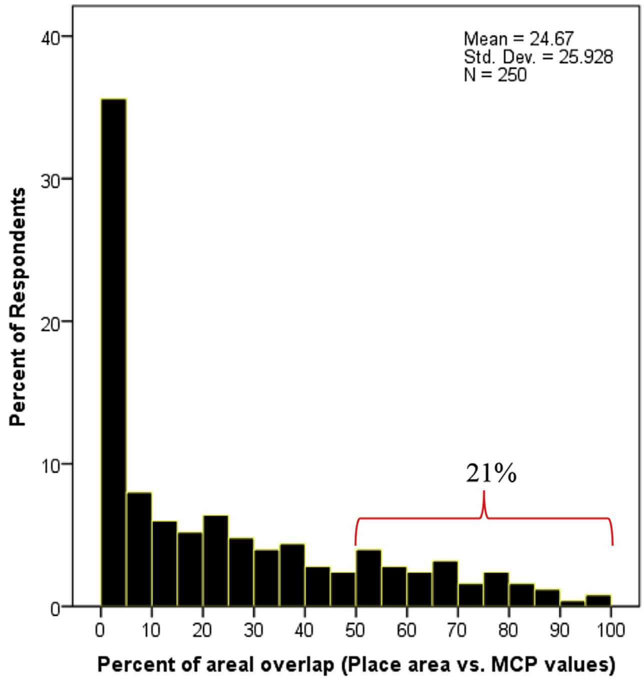

Fig. 5. Frequency distribution of spatial concurrence (overlap) between place area and MCP of values.

Values home range

Participants (n = 337) mapped value locations in the region using the provided typology of landscape values. The minimum convex polygon (MCP) of mapped values for each participant (termed *values home range*) was compared to the mapped place attachment area. The values home range area was significantly and positively correlated with place area ($r = 0.34$, $p \leq .05$) and significantly larger ($\bar{x}$=3007 km^2) on average to place area ($\bar{x}$=2061 km^2, $t = -2.84$, $p \leq .05$). There was greater overall variability in the values home range (SD = 5143 km^2) than place area (4020 km^2) with about 57% of participants identifying their values home range as being larger than the place area. About 37% of the participants identified value home range areas less than100 km^2.

Spatial concurrence of landscape values with place attachment

The percentage of landscape value points mapped within the place area polygon was calculated for each individual and averaged across all respondents. About 48% of all values were mapped inside the place boundary, but there were differences in percentage by landscape value type. Economic (agriculture) value (58%) and social value (52%) were more likely to be mapped inside the place area boundary. The least likely values to be mapped inside the place boundary were intrinsic/existence value (35%) and economic (tourism) value (39%).

The percent of spatial concurrence (polygon overlap) between place MCP and landscape value MCP was calculated for each participant and averaged across all participants. The mean percent of spatial concurrence was about 25% but there was a high degree of variability among participants (See Fig. 5). For example, there was less than 5% spatial concurrence for about 35% of participants while about 21% of the participants had spatial concurrence (overlap) greater than 50 percent. The method for generating the place attachment boundary and the value polygons influenced the level of spatial concurrence. For example, mean spatial concurrence was

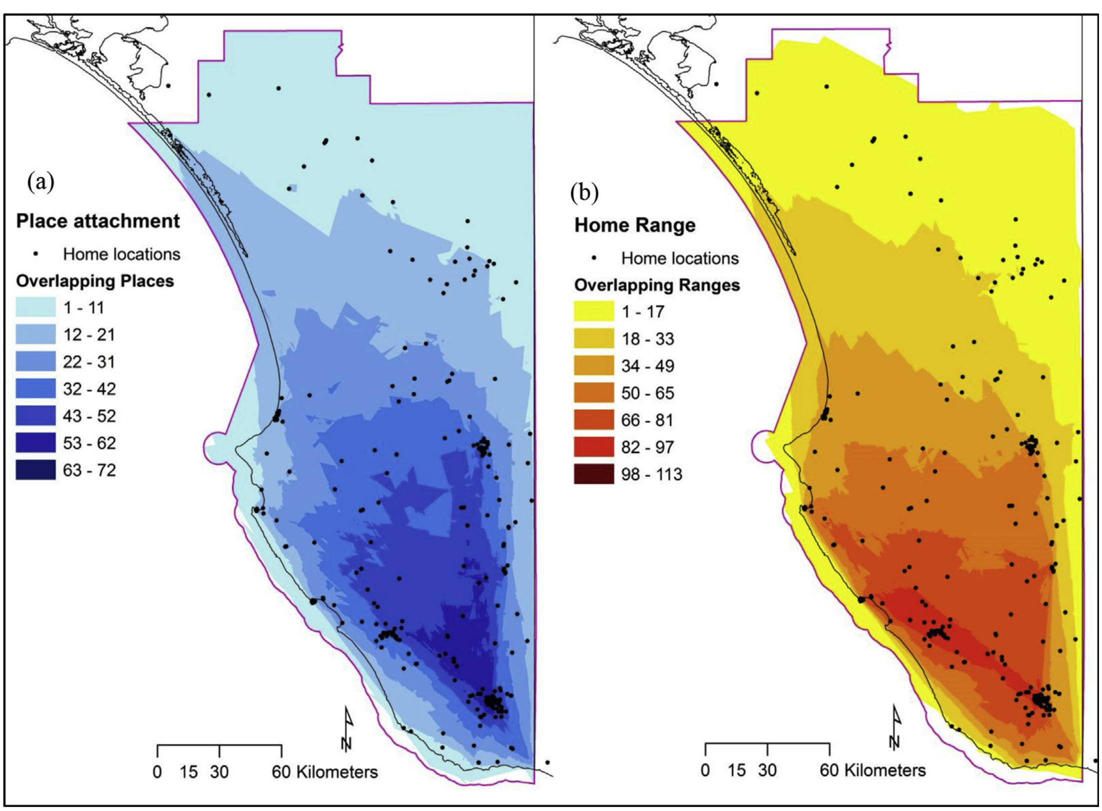

Fig. 6. Areas of overlapping (a) place attachment and (b) values home range (polygon method). The largest spatial overlap occurs in the south of the study region influenced by sampling distribution of participants.

29% for participants that placed 4 or more place bounding points and 34% for participants that placed 5 or more place bounding points.

To examine collective, regional results, the place attachment polygons were aggregated spatially by counting the number of overlapping place polygons. With n = 259 individuals identifying place polygons, the maximum potential count was 259 overlapping polygons. The actual maximum number of overlapping polygons was 72. For comparability, the overlapping polygon method was also used to identify overlapping value home ranges. The maximum potential polygon count was 337 with the actual maximum overlap count being 113. The results of the spatial aggregation for the region using the polygon method appear in Fig. 6. From visual inspection, the spatial concurrence of both place attachment and values home range are geographically situated in the southern reach of the study area, a finding consistent with the larger proportion of study participants living in the south.

While the MCP method is useful to compare the area of values home range with place attachment, the method was not a reliable predictor of landscape value intensity for the region due to a significant edge effect from the coastline that forms the western border of the region. Fig. 7 shows kernel densities of landscape value locations for all study participants in the region with a clearly identifiable coastal intensity of values that is not apparent in Fig. 6b. The polygon method distorts spatial intensities or "hotspots" of mapped locations in regions with a coastline. In a geographic setting with a clear edge effect, densities of mapped value locations provide a better indicator of the actual spatial location of mapped value intensity compared to the MCP polygon method.

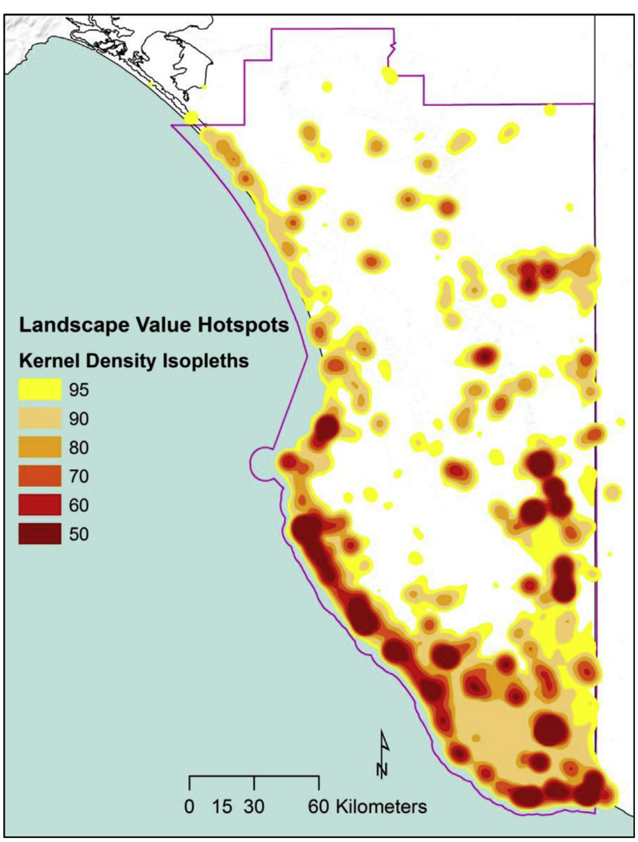

Fig. 7. Landscape value hotspots in the region using kernel density estimation with 1 km grid cell size and probability isopleths.

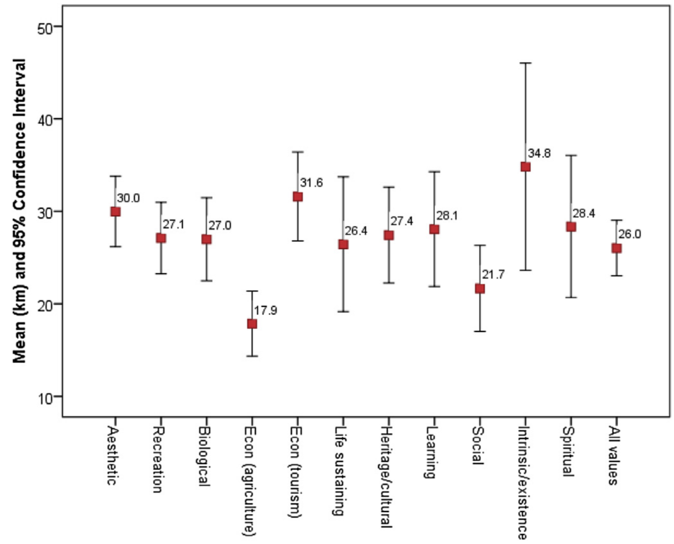

Fig. 8. Mean landscape value distances (km) from home location with 95% confidence intervals. Statistically significant differences occur where there is no overlap in confidence intervals.

Distance-based measures of values home range

An alternative approach to estimate the values home range is to use the mean distance from home location to mapped landscape values. Fig. 8 shows the mean distances (km) for each landscape value type as well as an overall mean distance for all landscape values combined. Economic values for agriculture and social values were mapped closest to home location while intrinsic/existence value and economic values for tourism were mapped furthest from home. When mean distance to landscape value was analyzed by participant variables, the results were similar to the MCP area-based analyses (see Table 2). There were weak, negative correlations between distance and age and years lived in the region, females mapped values at longer distances from home than men, farmers and rural participants mapped significantly shorter distances than other participants, and the mean distances for non-coastal residents were significantly larger than for coastal residents.

Discussion

As the first study to trial the direct mapping of place attachment through an internet-based PPGIS, there were few signposts for guiding the research design. Our research was necessarily exploratory to identify potential variables related to the spatial results as a guide to further development of spatially-explicit place attachment methods. The construct of place attachment has been the subject of extensive academic and literary attention, but not as a spatially explicit variable in PPGIS. The concept of a home range has also been studied extensively, but not as a human cognitive map of place.

We anticipated a high level of spatial variability in mapped place attachment given the general place attachment definition from the academic literature. Spatial variability manifested from three different sources: variability in participants through sampling design, variability in physical place features through selection of the study region, and variability in spatial measurement through PPGIS mapping options. While data variability is an essential part of research, random and unsystematic variation (bias) can obscure or confound otherwise significant relationships. We found large spatial variability in the direct mapping of place attachment using PPGIS methods and yet, a majority of participants identified their place attachment area as less than 100 km^2. The mapped values home range covered a somewhat larger area, on average, with economic livelihood values and social values more likely to be included in the place attachment area. The aggregated areas of place attachment and values home range within the region showed similar spatial intensity and were strongly influenced by the home locations of study participants. The kernel-based method for values aggregation of points generated different spatial intensities from the polygon aggregation method due to an edge effect associated with a coastline forming the western boundary of the study area.

Of the multiple participant variables examined, occupation and place of residence were most strongly related to mapped place attachment and values home range. Participants that identified with the farming sector had smaller areas of place attachment and values home range, while participants that identified with the conservation profession, especially individuals associated with natural resource management in the region, identified larger areas of place attachment and values home range. Participants that live in the coastal zone identified smaller areas of placement and values home range than non-coastal participants. These significant relationships held when analyzed using distance-based, rather than area-based measures. The larger area of place attachment and home range identified by conservation professionals could be partly attributed to their motivation to conserve large areas of land in the South East NRM region. It could also be related to their higher level of knowledge of specific types of conservation and landscape values across the region.

Our presupposition that place attachment is a spatial subset of one's cognitive values home range was generally supported by the results. The relative size of area covered by place attachment and home range were in the expected direction with more participants identifying a larger values home range, although the percent of spatial concurrence (overlap) between the two mapped areas was relatively small, about 25% on average. The area of spatial overlap was influenced by the method for identifying the place attachment bounding area with greater spatial overlap among participants that mapped four to five vertices over the minimum of three vertices.

The modest, quantitative spatial concurrence between mapped place attachment and the values home range was not surprising given the (1) absence of theory suggesting the constructs should be spatially related, (2) limited prior research finding only that place attachment and mapped landscape values were related non-spatially (Brown & Raymond, 2007), (3) the participant, place, and measurement variability inherent in the research design and results, and (4) the difference in mapping methods where place attachment was identified directly while the values home range was generated inductively from multiple spatial variables.

We suggest that mapping place attachment and a values home range represent two alternative, but related methods for assessing the importance of place that emphasize different foci in the valuation process. Mapped landscape values are *relationship* values that link *held* values (what is personally important) with *assigned* values (objects that have utility) (Brown & Donovan, 2014; Brown & Reed, 2012; Van Riper and Kyle, 2014). We speculate that in the process of mapping of landscape values, greater cognitive emphases is placed on locating places in the study landscape that are perceived to have the qualities (*assigned* values) over what is personally important (*held* values). In mapping place attachment, the cognitive emphasis shifts and held values assume a somewhat more prominent role than assigned values in delineating the place attachment area. In some cases, place attachment may not be attributable to either held or assigned values, as shown by places associated with bad memories or feelings of fear (Manzo, 2005). Incorporating spatially explicit landscape threats into future empirical assessments of a values home range may enhance our understanding of the convergence (or lack thereof) between the place attachment and value home range constructs.

We believe the direct mapping of place attachment identifies a more affective, personal connection to place that could be linked with place-protective action (Devine-Wright 2009) and the Not-in-My-Backyard (NIMBY) phenomenon wherein a person's home and proximity to a perceived threat is a significant factor influencing a response (Pocewicz and Nielsen-Pincus, 2013; Warren, Lumsden, O'Dowd, & Birnie, 2005). In contrast, a *values home range* represents an individual's awareness of the various resources available in the region whose importance adjusts over time and includes places that people know but do not necessarily use or visit. As Powell and Mitchell (2012) caution, any type of home range (cognitive or behavioral) is at best, a limited model of reality.

We further speculate that the human ability to cognitively associate the importance of place in non-personal terms (i.e., what is valuable to others) results in a larger mapped area. For example, one can be aware of the important features of the region that contribute significantly to tourism benefits, but not necessarily associate high personal value with these places. However, the distinction between cognitive understanding of place and more affective place attachment cannot be readily discerned using the participatory mapping methods described herein.

Mapping the future of place attachment

While there has been considerable academic writing on place attachment, the practical application of place attachment beyond the hypothetical has been minimal. Does the concept of place attachment have practical utility for land use planning, decision support, or spatial problem solving? This issue was raised by Raymond (2013) in a review of the *Place Attachment* book edited by Manzo and Devine-Wright (2014). An objective assessment would conclude that place attachment research has not achieved significant practical planning or decision support impact to date. However, it is also true that there has been very limited research effort to operationalize the place attachment concept as described in this paper. Arguably, until place attachment can be meaningfully rendered on a map, it will not be influential for land use planning and decision support. Further, the mapping of place attachment must be more than descriptive—it must be capable of predicting outcomes related to prospective land use. The temporal dynamism of place attachment should also be considered because the intensity or structure of place attachment may change over an individual's lifetime, suggesting the need for longitudinal studies in addition to cross-sectional research.

If place attachment can be made spatially explicit, how could it be used? Following Devine-Wright (2009), mapped place attachment could be used to identify areas were place-protective actions would be strongest within a planning region, enabling planning practitioners to spatially target management and community engagement efforts (e.g., engagement on wind-farm developments) to known areas of local concern. This purpose is related to research by Brown and Raymond (2014) that describe how mapped landscape values, in combination with spatially explicit land use preferences, can be used identify regional areas with the greatest potential for land use conflict. Place attachment can also operate in an affirmative direction to identify areas where proactive actions such as the conservation and restoration of native vegetation would more likely be effective (Raymond & Brown, 2011).

Whereas place attachment appears to be a rather blunt instrument to assess the potential for place-protective and place-enhancement behavior, mapped landscape values provide more specific information about the potential motivations for place-based behavior over a larger geographic area. At the outset of this study, we posited that mapped place attachment and a values home range might be similar in spatial extent and thus could be used interchangeably in PPGIS. Our results do not support this conclusion. If not spatially comparable constructs, we further posited that place attachment and values home range would at least be synergetic, providing the possibility of spatial calibration of one construct based on the other. However, assessing the synergy of the two constructs, as operationalized in this study, requires further trials. Because the spatially explicit measurement of place attachment was one of multiple research objectives within the project, it was not possible to implement PPGIS data collection for the exclusive purpose of measuring and mapping place attachment. Therefore, we offer the following recommendations for future research to advance the mapping, measurement, and calibration of place attachment.

Recommendations to advance the mapping of place attachment

Assess the intensity and structure of place attachment

Scale-based psychometric measures of place attachment measure the intensity and structure of place attachment and its multiple dimensions, most commonly identified as place *identity* and *dependence*. The place attachment mapping method described herein locates an area of place attachment, but does not assess the structure or intensity of place attachment. Intensity of place attachment could be assessed by including non-spatial, scale-based measures of place-attachment in survey questions that follow mapping of the place attachment area.

Offer greater mapping precision

The method described herein provided one of the simplest possible methods in web-based PPGIS to delineate a polygon area by having the participant identify three bounding points. The participant was not required to connect the points nor make judgments about locating boundary lines that are required when drawing polygons. The simplicity of the method was a design trade-off against the potential for greater spatial precision which can be obtained by requiring more bounding points or the actual drawing of a polygon. Although participants could delineate highly complex place attachment geometries by using unlimited points, the majority of participants opted for a three point polygon area. Future research could offer participants the option to use other mapping methods such as actual polygon drawing to more precisely delineate the area of place attachment.

Link/associate place attachment to mapped landscape values

As observed in this study, mapped landscape values were indirect and highly variable indicators of place attachment. Some landscape values appeared more related to place attachment than other values. The PPGIS mapping process did not explicitly request that the participant make a cognitive association between place attachment and the values to be mapped in the region. It would be relatively easy to ask the participant if each mapped landscape value should be considered inside or outside his/her place attachment area without the need to explicitly identify a place attachment area. Alternatively, the study participant could be asked how the mapped landscape value contributes (or not) to personal place identity and/or dependence.

Link place attachment mapping to place-inspired behavior

An important deficiency in place attachment research is the putative relationship with place-inspired behavior. Most research has focused on place-protective actions recognizing that humans often engage in conservation behaviors when they perceive their ‘local places’ are under threat from development, among other anthropogenic influencers (Devine-Wright, 2009). Mapped placed attachment could be linked to a set of behavioral intentions for a list of proposed threats or alternatively, place enhancements. For example, a range of potential behaviors (e.g., attending a meeting, contacting a political representative, planting/caring for trees) could be asked to determine the depth of commitment to place-protective or place-enhancement behaviors once the place attachment area is delineated. Alternatively, the location of potential place-inspired behaviors could be mapped and place attachment inductively inferred from the aggregated locations. For example, “identify places in the study region that if changed, would inspire you to take protection action …” or “identify places in the study region where you would volunteer or work to improve the condition …” The limitation for this type of approach is that one can be attached to a place but not engage in behavior that is consistent with the attachment. If the place attachment concept is to have utility for land use planning and decision support in the future, it must be operationalized, measured, and calibrated to the point which it can be shown to predict certain events or outcomes.

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References

Auricht, C. M., Raymond, C., Thackway, R., & Imgraben, S. (2014). *Development of socio-ecological subregional boundaries for Natural Resources Management in the South East NRM Region*. Report prepared for SE NRM Board by Auricht Projects, Brighton, South Australia.
Beyer, H. L. (2014). *Geospatial modeling environment*. Retrieved from http://www.spatialecology.com. October 30, 2014.
Bricker, K. S., & Kerstetter, D. L. (2000). Level of specialization and place attachment: an exploratory study of whitewater recreationists. *Leisure Sciences, 22*(4), 233–257. Retrieved from <Go to ISI>://WOS:000165674500002.
Brown, G. (2005). Mapping spatial attributes in survey research for natural resource management: methods and applications. *Society & Natural Resources, 18*(1), 1–23.
Brown, G. (2013a). The relationship between social values for ecosystem services and global land cover: an empirical analysis. *Ecosystem Services, 5*, 58–68.
Brown, G. (2013b). Relationships between spatial and non-spatial preferences and place-based values in national forests. *Applied Geography, 44*, 1–11.
Brown, G., & Donovan, S. (2014). Measuring change in place values for environmental and natural resource planning using Public Participation GIS (PPGIS): results and challenges for longitudinal research. *Society & Natural Resources, 27*(1), 36–54.
Brown, G., & Fagerholm, N. (2014). Empirical PPGIS/PGIS mapping of ecosystem services: a review and evaluation. *Ecosystem Services*. http://dx.doi.org/10.1016/j.ecoser.2014.10.007.
Brown, G., Kelly, M., & Whitall, D. (2014). Which “public”? Sampling effects in public participation GIS (PPGIS) and Volunteered Geographic Information (VGI) systems for public lands management. *Journal of Environmental Planning and Management, 57*(2), 190–214.
Brown, G., & Kyttä, M. (2014). Key issues and research priorities for public participation GIS (PPGIS): a synthesis based on empirical research. *Applied Geography, 46*, 122–136.
Brown, G., & Raymond, C. (2007). The relationship between place attachment and landscape values: toward mapping place attachment. *Applied Geography, 27*(2), 89–111. http://dx.doi.org/10.1016/j.apgeog.2006.11.002.
Brown, G., & Raymond, C. (2014). Methods for identifying land use conflict potential using participatory mapping. *Landscape and Urban Planning, 122*, 196–208.
Brown, G., & Reed, P. (2009). Public Participation GIS: a new method for national forest planning. *Forest Science, 55*(2), 166–182.

Brown, G., & Reed, P. (2012). Values compatibility analysis: integrating public values in a forest planning decision support system. *Applied Spatial Analysis and Policy, 5*(4), 317–332.

Brown, G., Reed, P., & Harris, C. (2002). Testing a place-based theory for environmental evaluation: an Alaska case study. *Applied Geography, 22*(1), 49–77.

Brown, G., & Weber, D. (2012). Measuring change in place values using public participation GIS (PPGIS). *Applied Geography, 34*, 316–324.

Brügger, A., Kaiser, F. G., & Roczen, N. (2011). One for all? Connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. *European Psychologist, 16*(4), 324–333. http://dx.doi.org/10.1027/1016-9040/a000032.

Burgman, M. A., & Fox, J. C. (2003). Bias in species range estimates from minimum convex polygons: implications for conservation and options for improved planning. *Animal Conservation, 6*(01), 19–28.

Burt, W. H. (1943). Territoriality and home range concepts as applied to mammals. *Journal of Mammalogy, 24*(3), 346–352.

Cacciapaglia, L., & Yung, M. (2013). Participatory place mapping in fire planning. In W. Stewart, D. Williams, & L. Kruger (Eds.), *Place-based conservation: Perspectives from the social sciences* (pp. 306–328). New York: Springer.

Christensen, N., & Burchfield, J. (2013). Community-based place attachment to public land. In W. Stewart, D. Williams, & L. Kruger (Eds.), *Place-based conservation: Perspectives from the social sciences* (pp. 376–403). New York: Springer.

Devine-Wright, P. (2009). Rethinking NIMBYism: the role of place attachment and place identity in explaining place-protective action. *Journal of Community & Applied Social Psychology, 19*(6), 426–441.

Di Masso, A., Dixon, J., & Durrheim, K. (2014). Place attachment as discursive practice. In *Place attachment: Advances in theory, methods and applications* (pp. 75–86).

Gunderson, K. (2006). Understanding place meanings for wilderness: personal and community values at risk. *International Journal of Wilderness, 12*(1), 27–31.

Hammitt, W. E., Backlund, E. A., & Bixler, R. D. (2004). Experience use history, place bonding and resource substitution of trout anglers during recreation engagements. *Journal of Leisure Research, 36*(3), 356–378.

Hammitt, W. E., Kyle, G. T., & Oh, C. O. (2009). Comparison of place bonding models in recreation resource management. *Journal of Leisure Research, 41*(1), 57–72.

Hidalgo, M. C. C., & Hernández, B. (2001). Place attachment: conceptual and empirical questions. *Journal of Environmental Psychology, 21*(3), 273–281. http://dx.doi.org/10.1006/jevp.2001.0221.

Kyle, G., Graefe, A., & Manning, R. (2005). Testing the dimensionality of place attachment in recreational settings. *Environment and Behavior, 37*(2), 153–177. http://dx.doi.org/10.1177/0013916504269654.

Lin, C.-C., & Lockwood, M. (2014). Forms and sources of place attachment: evidence from two protected areas. *Geoforum, 53*, 74–81. http://dx.doi.org/10.1016/j.geoforum.2014.02.008.

Manzo, L. C. (2005). For better or worse: exploring multiple dimensions of place meaning. *Journal of Environmental Psychology, 25*(1), 67–86. http://dx.doi.org/10.1016/j.jenvp.2005.01.002.

Manzo, L. C., & Devine-Wright, P. (2014). *Place attachment: Advances in theory, methods and applications*. Oxon: Routledge.

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: a measure of individuals' feeling in community with nature. *Journal of Environmental Psychology, 24*(4), 503–515. Retrieved from <Go to ISI>://WOS:000227784800007.

Mihaylov, M., & Perkins, D. D. (2014). Community place attachment and its role in social capital development. In *Place attachment: Advances in theory, methods and applications* (pp. 61–74).

Moore, R. L., & Graefe, A. R. (1994). Attachments to recreation settings: the case of rail-trail users. *Leisure Sciences, 16*(1), 17–31.

Patterson, M. E., & Williams, D. R. (2005). Maintaining research traditions on place: diversity of thought and scientific progress. *Journal of Environmental Psychology, 25*(4), 361–380. http://dx.doi.org/10.1016/j.jenvp.2005.10.001.

Perkins, D. D., & Long, A. D. (2002). Neighborhood sense of community and social capital: a multi-level analysis. In A. Fisher, C. Sonn, & B. Bishop (Eds.), *Psychological sense of community: Research, applications and implications*. New York: Plenum Press.

Pocewicz, A., & Nielsen-Pincus, M. (2013). Preferences of Wyoming residents for siting of energy and residential development. *Applied Geography, 43*, 45–55.

Powell, R. A. (2000). Animal home ranges and territories and home range estimators. In L. Boitani, & T. K. Fuller (Eds.), *Research techniques in animal ecology: Controversies and consequences* (pp. 65–110). New York: Columbia University Press.

Powell, R. A., & Mitchell, M. S. (2012). What is a home range? *Journal of Mammalogy, 93*(4), 948–958.

Proshansky, H. M., Fabian, A. K., Kaminoff, R., Library, A., & Raymond, C. (1983). Place-identity: physical world socialization of the self. *Journal of Environmental Psychology, 3*(1), 57–83. Retrieved from http://www.sciencedirect.com/science/article/B6WJ8-4GK8NNF-5/2/caf48335742164922b3d8e01630ca97f.

Raymond, C. (2013). In L. Manzo, & P. Devine-Wright (Eds.), *Estudios de Psicología: Vol. 34(3). Review of "place attachment: Advances in theory, methods and applications* (pp. 345–348).

Raymond, C., & Brown, G. (2011). Assessing conservation opportunity on private land: socio-economic, behavioral, and spatial dimensions. *Journal of Environmental Management, 92*(10), 2513–2523.

Raymond, C. M., Brown, G., & Weber, D. (2010). The measurement of place attachment: personal, community and environmental connections. *Journal of Environmental Psychology, 30*, 422–434.

Schreyer, R., Jacob, G., & White, R. (1981). Environmental meaning as a determinant of spatial behaviour in recreation. In *Proceedings applied geography conference* (vol. 4, pp. 294–300).

Schultz, P. W., Shriver, C., Tabanico, J. J., & Khazian, A. M. (2004). Implicit connections with nature. *Journal of Environmental Psychology, 24*(1), 31–42. Retrieved from http://www.sciencedirect.com/science/article/B6WJ8-48XD4H5-1/2/6deac88664a7a952a46c2c558da1f295.

Seamon, D. (2014). Place attachment and phenomenology: the synergistic dynamism of place. In *Place attachment: Advances in theory, methods and applications* (pp. 11–22).

Sherrouse, B. C., Clement, J. M., & Semmens, D. J. (2011). A GIS application for assessing, mapping, and quantifying the social values of ecosystem services. *Applied Geography, 31*(2), 748–760.

South Australian Tourism Commission. (2012). *Limestone coast regional tourism profile 2010–2012*. Adelaide: South Australian Tourism Commission Accessed online http://tourism.sa.gov.au/assets/documents/Limestone_Coast.pdf.

South East NRM Board. (2010). *Healthy landscapes for better living. Part one: Regional description*. Mount Gambier: South East Natural Resources Management Board.

Stokols, D., & Shumaker, S. A. (1981). People in places: a transactional view of settings. In J. Harvey (Ed.), *Cognition, social behavior, and the environment* (pp. 441–488). Hillsdale, NJ: Erlbaum.

Trentelman, C. K. (2009). Place attachment and community attachment: a primer grounded in the lived experience of a community sociologist. *Society & Natural Resources, 22*(3), 191–210.

Van Riper, C. J., & Kyle, G. T. (2014). Capturing multiple values of ecosystem services shaped by environmental worldviews: a spatial analysis. *Journal of Environmental Management, 145*, 374–384.

Warren, C. R., Lumsden, C., O'Dowd, S., & Birnie, R. V. (2005). 'Green on green': public perceptions of wind power in Scotland and Ireland. *Journal of Environmental Planning and Management, 48*(6), 853–875.

Williams, D. (2013). Science, practice and place. In W. Stewart, D. Williams, & L. Kruger (Eds.), *Place-based conservation: Perspectives from the social sciences* (pp. 21–34).

Williams, D. R. (2014). Making sense of "place": reflections on pluralism and positionality in place research. *Landscape and Urban Planning, 131*, 74–82. http://dx.doi.org/10.1016/j.landurbplan.2014.08.002.

Williams, D. R., Patterson, M. E., Roggenbuck, J. W., & Watson, A. E. (1992). Beyond the commodity metaphor – examining emotional and symbolic attachment to place. *Leisure Sciences, 14*(1), 29–46.

Williams, D., Stewart, W., & Kruger, L. (2013). Place-based conservation: advancing social theory and practice. In *Place-based conservation: Perspectives from the social sciences* (pp. 2–28). New York: Springer.

Williams, D. R., & Vaske, J. J. (2003). The measurement of place attachment: validity and generalizability of a psychometric approach. *Forest Science, 49*(6).