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Using public participation GIS (PPGIS) on the Geoweb to monitor tourism development preferences

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This paper presents a method for identifying and monitoring regional tourism development preferences using an Internet public participation geographic information system (PPGIS). In 2004, a large baseline study of landscape values and development preferences was completed on Kangaroo Island (KI), South Australia, using low technology, paper-map PPGIS. In 2010, we implemented an Internet-based PPGIS monitoring study with the same participants to (1) determine the efficacy of smaller scale monitoring efforts using an Internet-based PPGIS, (2) examine whether residents' tourism development preferences had changed over the last six years and (3) assess the strengths and weaknesses of the PPGIS methodology for identifying changes in tourism development preferences. Since KI is the first international tourism destination to adopt the Tourism Optimization Management Model (TOMM) for monitoring tourism outcomes, we contrast the PPGIS monitoring method with information from the TOMM process. Our results indicate that tourism development preferences remained relatively stable over the past six years with some small changes on the western reach of the island. We argue that an Internet-based PPGIS method can be an effective tool for tourism development planning and monitoring because the method is place-based, cost-effective and provides tighter coupling with land use planning controls such as zoning.

Keywords: participatory GIS; PPGIS; tourism development; community participation; monitoring; TOMM

Introduction

Coastal tourism is a diverse, fast-growing and economically attractive form of contemporary tourism (Dowling & Pforr, 2009). While it can deliver positive socio-economic benefits, Wesley and Pforr (2010) warn that with lack of consideration to place meaning and governance processes, coastal tourism can undermine the social-cultural and ecological systems of an area. On South Australia's Kangaroo Island (KI), a tourism monitoring system has been in place for over a decade with the goal of creating a sustainable tourism industry. However, a 2004 tourism planning study revealed that coastal development and community engagement processes were a major concern of Island residents (Brown, 2006). This study reassessed the situation on KI six years later using public participation geographic information system (PPGIS). In this paper, we present the results of a longitudinal study to illustrate the use of a tourism research methodology that uses PPGIS to identify tourism development preferences and argue that it is a cost-effective method of

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engaging the public in the planning process that yields critical spatial information. The spatial nature of the data not only means that this can be easily integrated with other planning layers but, most important, this also acknowledges the tourism axiom that place matters.

The term "public participation geographic information systems" was conceived in 1996 at the meeting of the National Center for Geographic Information and Analysis (NCGIA). PPGIS combines the practice of GIS and mapping at local levels to produce knowledge of place. The formal definition of PPGIS is nebulous (Tulloch, 2007) with use of the term "PPGIS" emerging from the context of a developed country, while the term participatory GIS or "PGIS" is often used to describe participatory planning approaches in rural areas of developing countries, the result of a merger between Participatory Learning and Action (PLA) methods and geographic information technologies (Rambaldi, Kwaku Kyem, Mbile, McCall, & Weiner, 2006). Since the 1990s, the range of PPGIS applications has been extensive, ranging from community and neighborhood planning to mapping traditional ecological knowledge of indigenous people (see Brown, 2005; Dunn, 2007; Sawicki & Peterman, 2002 and Sieber, 2006 for reviews of PPGIS applications).

Public participation in tourism

Since the 1972 United Nations Conference on the Human Environment, there has been increasing recognition of the importance of public participation as a mechanism to allow communities to have greater control in decision-making and the benefits that flow to them (Hall & Lew, 1998). Tourism development should be economically viable, environmentally sensitive and commensurate with the aspirations of host communities (Milne, 1998) where residents participate in the decision-making process to translate community values into sustainable directives (Sofield, 2003). Public participation in tourism planning can assume a number of different forms and serve a diversity of purposes. The International Association of Public Participation's (2012) scale of public participation includes five levels ranging from an informative role to consultation, involvement, collaboration and empowerment. Each of these levels is legitimate depending on the goals, time frames, resources and the salience of the issue. Common methods used to involve public in tourism planning include public meetings, focus groups, interviews with key stakeholders and workshops. The choice of appropriate participation methods must consider the desired output from the participation and the current stage of planning (Simmons, 1994). Typically, a combination of approaches is used (Brown & Weber, 2011; Stone & Stone, 2011) and there is an increasing demand for methods that are convenient, where participants feel the benefits of participation outweigh the efforts involved (Weber, 2007).

While traditional participatory methods have seen recent innovation, for example, the use of audience response systems (Keske & Smutko 2010), the Internet offers special potential as a mechanism to assist public participation. It is a convenient, low cost method that can be accessible to many people. In South Australia, 76% of the population has access to the Internet, compared with a national average of 82% (Australian Bureau of Statistics, 2011). The main population areas on KI have Internet access. While informative websites, the Internet-based surveys, blogs and even draft plans created via the Internet-based wikis (Brown & Weber, 2011) have been increasingly used to aid the public participation process, these methods often have limited spatial components. Considering the fundamental importance of spatial data to planning, application of an Internet-based GIS platform that allows the public to identify specific areas they are concerned about, or areas where they

would support tourism development, seems a prudent advance that can complement existing participation methodologies.

Brown (2006) completed the first PPGIS study (data was collected in 2004) to identify spatial measures of residential and tourism development preferences for an international tourism destination on KI. The PPGIS methodology was posited to fill a gap where the use of GIS in tourism research was "minimal" (Allen, Lu, & Potts, 2002) or "neglected" (Farsari, 2003), despite an earlier and hopeful view that GIS could be used for sustainable tourism planning to explore conflicts and assist decision-making (Behaire & Elliott-White, 1999; Feick & Hall, 1999). Stewart, Jacobson, and Draper (2008) described numerous challenges with implementing a participatory process with a heterogeneous community in Churchill, Manitoba, yet concluded that PPGIS can yield positive outcomes for communities and academia. Similarly, Hasse and Milne (2005) used a participatory GIS process in Marahau, New Zealand, and reported that the method has the potential to play an important role in enhancing sustainable tourism development outcomes.

Since the publication of the initial Kangaroo Island PPGIS study, the merits of using participatory GIS systems to assist in regional tourism planning decision-making have been described (Taranto, 2007), but the adoption of PPGIS methods for tourism planning and decision-making has been limited. Brown and Weber (2011) used the technique to evaluate visitor perceptions of park experiences, environmental impacts and facility needs in a study of the Greater Alpine region in Victoria, Australia. Raymond and Brown (2007) used the PPGIS methodology in the Otways region of Victoria, Australia, similar to the baseline KI study and concluded that the PPGIS method has potential to bridge pro-development and antidevelopment responses by providing development preference data that are applicable to both local and regional scales.

Linking participation to tourism planning

While the participatory method selected must reflect the needs of the project and engage the public's interest to be successful, it is vital that attention be given to how the results can be used. Ideally, the participation process should be linked strongly with statutory planning mechanisms (Simmons, 1994). But examples of tightly coupled linkages between community participation and successful tourism planning outcomes remain sparse (Butcher, 2010; Weaver, 2010). Wray (2011) describes a detailed review of a recent major community participation project, but even this long-term and very resource-intensive project was not fully successful. Most participation processes do not provide spatially explicit outcomes that can be readily incorporated into existing land use planning and development processes. Although the PPGIS methodology described in this paper was not formally coupled with tourism planning on KI, it provides the potential for more direct linkage to statutory land use planning. Current tourism planning and monitoring on KI is based on the Tourism Optimisation Management Model (TOMM), described below. Implicit in this process is an understanding that coastal development is an important and contentious issue, yet the indicators prescribed in TOMM do not address tourism development directly. It is posited that use of a PPGIS as part of the long-term TOMM monitoring system could yield improved community preference information and identify likely conflict. More important, the spatial information provided through PPGIS can be used to link tourism planning with general land use planning and development decisions that are currently at best, loosely coupled.

Case study: Kangaroo Island

Kangaroo Island, located 15 km off the mainland coast of South Australia and at 4500 km^2, is Australia's third-largest island (after Tasmania and Melville Island off the coast of Darwin). The island offers a varied landscape ranging from soaring cliffs, spectacular beaches, dense forest and wetlands. Over half of the island is native vegetation, and much of this is protected as national parks and conservation areas (Figure 1; please note that the figures in this paper are best viewed via the online version of the paper at www.tandfonline.com/JOST). The 4400 residents reside primarily in the largest town of Kingscote, and smaller townships of Penneshaw, Parndana, America River and Emu Bay (Tourism SA, 2012). The island is promoted as a world-class nature-based tourist destination and is important to both the state and the national tourism industry. The pristine beaches and abundant wildlife attract over 186,000 tourists annually, of which approximately 30% are international tourists (TOMM, 2010). It is listed as one of the 12 "national landscapes" by Tourism Australia (2011), and has received numerous awards, ranging from the best Australian experience, the best eco-destination in Australia and the number one island in Asia Pacific; and in 2009 the Southern Ocean Lodge on KI was awarded the best hotel in the world by Tattler magazine (Tourism SA, 2012).

For tourism to achieve positive social, economic and environmental outcomes, there is a need to develop, implement and monitor sustainable tourism indicators (Miller & Twining-Ward, 2005). Kangaroo Island was the first tourism destination to implement TOMM (Mandis Roberts Consultants, 1997). TOMM was promoted as a community-based initiative to monitor the long-term health of tourism industry on KI with indicators designed to measure the health of the economy, the number and type of tourists visiting, the health of the environment, the type of experiences visitors are having and the health of the community. TOMM was developed not only to monitor tourism activity and impacts but also to help the community make better decisions about tourism.

An assessment of TOMM's implementation on KI after a decade suggests that TOMM's vision has not been fully realized. In particular, the effective implementation of management responses to indicators has been slow, leading to criticism from some sectors of the community (Miller & Twining-Ward, 2005). Frustration appears to derive from the inability of TOMM to answer specific questions about tourism development, the weakness of

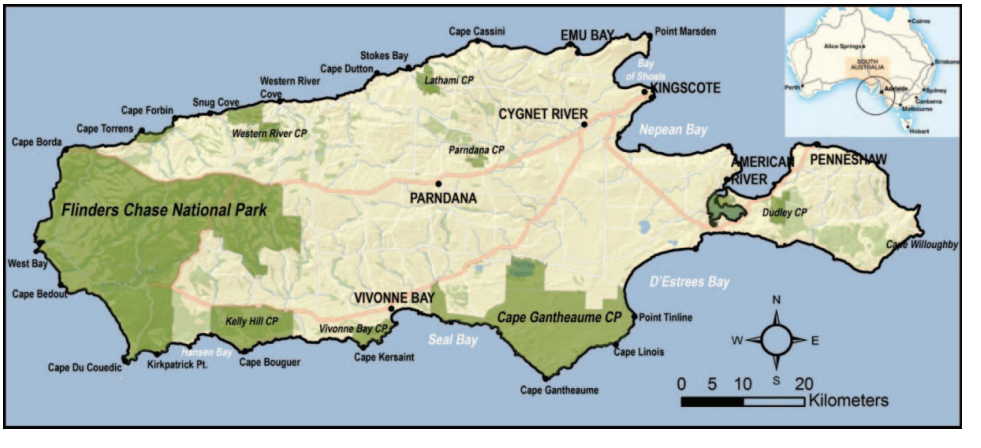

Figure 1. Location map for Kangaroo Island, South Australia. Source: Author.

environmental indicators and the pace of implementation, wherein not all indicators are being fully reported. The primary sources of information for TOMM are annual visitor and resident surveys commissioned by the TOMM KI Committee and conducted by Colman Brunton, an independently owned market research company. The TOMM KI Committee includes representatives from the community, South Australian Tourism Commission, Tourism KI, KI Council, Regional Development Australia, Department of Environment and Natural Resources and the Natural Resource Management Board. The information collected for TOMM is cross-referenced with information collected by the South Australian Department of Environment and Natural Resources (state management agency responsible for national parks), SeaLink (ferry), Regional Express (airline), Kangaroo Island Visitor Information Centre and South Australia Police. The TOMM project does not have a sustainable funding source and relies on the TOMM KI committee partners to fund its limited annual budget. In the past that funding has supported a part-time staff.

The efforts to develop and build an integrated system such as TOMM for identifying, collecting and monitoring indicators of sustainable tourism are commendable. It is one of the longest-running intensive monitoring programs in Australia, having maintained data collection on specific social, environmental and economic indicators for over a 10-year period and has been instrumental in a number of very positive sustainable initiatives. We argue, however, that TOMM fails to collect and monitor one of the more important indicators of social acceptance of tourism (one component of the sustainability triad) and one of the greatest sources of conflict – location preferences for tourism development (accommodation, services and transportation), including holiday homes. For example, in the Brown (2006) PPGIS study, the spatial results indicated high potential for tourism development conflict in the Hansen Bay area of KI, a natural area located on the southern coast. The resident PPGIS data indicated tourism development preferences overlapped with no development preferences for the area, with the majority of residents expressing a view that tourism was not appropriate for this area. In 2008, the controversial Southern Ocean Lodge, a luxury "eco-retreat" was built in the area. TOMM was not in a position, and arguably, not designed to provide basic guidance about whether tourism development is appropriate in specific areas of KI. Since the South Ocean Lodge development, the TOMM KI Committee has included a number of new indicators to assess the issue of tourism development, for example "Tourism development occurring in line with community values" and "overdevelopment as a driver for resident to leave Kangaroo Island" (Colmar Brunton, 2010). However, these indicators are not spatial, and yet, in a nature-based tourism destination, place matters. Government land use plans, such as the KI Development Plan (Government of SA, 2011; Planning SA, 2003), provide some guidance through zoning, but in this case the plan's environmental constraints for development in the coastal landscape zone in Hansen Bay (Planning SA, 2003) was not sufficient to preclude the development of a $15 million resort with 25 accommodation suites and associated facilities, including a main lodge, spa retreat and staff village (Planning SA, 2003). The resort was approved as a "Major Development" under the state's Development Act (*The South Australian Government Gazette*, 19 October 2006, pp. 3725–3727) because it required the removal of native vegetation. More details of tourism development and governance issues on KI can be found in Higgins-Desbiolles (2011).

The coupling of tourism destination planning with general land use planning decisions remains weak and unsystematic. Within the tourism destination research literature, there is increased interest in residents' attitudes toward tourism development but "only a handful of articles on tourism planning have found their way into the planning literature" (Harrill, 2004, p. 251). Dredge (1999, p. 773) observes that "despite considerable advancement in

the development of methodological processes of tourism planning ... there is a lack of spatial concepts, models, and theories from which the land use planner can draw".

We posit that PPGIS systems, if implemented effectively, provide indicators for monitoring changes in spatial development preferences over time while providing opportunities for tighter coupling of tourism development preferences with land use planning systems. The collection of spatial data is especially relevant because traditional survey research that provides the basis for tourism monitoring in TOMM can miss important place-based shifts in development preferences, both from visitors and residents.

In 2010, we developed and implemented a cost-effective Internet-based PPGIS system for assessing and monitoring tourism development preferences that were first measured in the 2004 study. Our purpose here is to describe the methods used, provide key results and assess the relative strengths and weaknesses of the approach. Specific research questions examined include the following: (1) Are the characteristics of the 2010 respondents similar to the 2004 respondents to allow meaningful comparison? (2) Have there been changes in the general tourism preferences (non-spatial) of KI residents between 2004 and 2010 that may be reflected in the spatial results? (3) What is the spatial distribution of tourism development preferences on KI, and have these changed since 2004? In the discussion, we evaluate the results and our experience with the Internet-based PPGIS monitoring system and discuss the benefits and challenges of integrating PPGIS systems into tourism destination planning systems.

Methods

Data collection process

To conduct the 2010 longitudinal monitoring study, we mailed letters of invitation to the same KI households that were randomly selected in 2004 ($n = 967$). This list included both participants and non-participants from 2004 list. Given the time lapse of six years, we anticipated a higher percentage of returned or undeliverable letters, even though the letter was addressed to the same person in 2004 "or current resident". The letter requested participation in the 2010 study, provided the study website URL and included a unique seven-digit access code that was keyed to the sampled household. The letter of invitation stated the following:

> In 2004, you or someone living at this postal address participated in a University of South Australia study that asked KI residents what they value about KI and their future development preferences. Since that time there have been some major changes in terms of development on the Island. We would like to update information regarding residents' preferences for development and have this information available for use in future planning decisions. By participating in this study, you will have an opportunity to express your opinions about the qualities of KI you would like to see preserved and those you would like to see changed. You will also have the ability to see the development/conservation preferences expressed by KI residents in 2004.

The study website consisted of an opening screen for the participant to enter their access code, followed by an informed consent screen and then the Google Maps application that allowed the participant to drag and drop different digital markers onto the web map of KI. See Figure 2 for a screen image of the application interface. The instructions provided requested the participant to

> use the map markers to identify the places you value and where you would like to see future development, or where you would like to see future development limited or prohibited. With your mouse, click on a marker and drag it onto the relevant map location.

Figure 2. Screen capture of PPGIS system for monitoring development preferences. Participants drag and drop markers in the panel (left) onto the Google map image. Each marker may be optionally annotated.

The different types of markers placed and their spatial locations were recorded for each participant. Of relevance to this study were three types of markers that favored future tourism development (tourism accommodation, tourism services and campgrounds) and three types of markers opposing new tourism development (no tourism accommodation, no tourism services and no development of any type). Participants could place as few or as many markers as they deemed necessary to express their preferences.

Following completion of the mapping activity (placing markers), participants were directed to a new screen and provided with a set of text-based survey questions to assess general and non-spatial development preferences, and to measure respondent socio-demographic characteristics. Five tourism and development questions were replicated from the 2004 baseline survey in addition to socio-demographic questions that assessed respondent characteristics (see Tables 1 and 2). Data collection concluded with participant completion of the survey questions. Study participants had the option to return to the website later and use their access code to add new markers or adjust previously placed markers.

Analyses

Respondent characteristics

In order to assess the similarity of 2010 respondents with the 2004 respondents, we examined socio-demographic variables common to both the studies: age, gender, length of residence and two items that asked about the respondent's level of familiarity with places on KI. Frequency distributions and descriptive statistics were generated for each variable depending on the variable's level of measurement.

Changes in tourism and development preferences

In order to assess general changes in tourism and development preferences, we analyzed five survey items replicated from the 2004 baseline study. These items asked about the type of development most likely to contribute to the island's future economic prosperity and community well-being, beliefs about the preferred level of coastal and non-coastal

Table 1. Respondents' socio-demographic characteristics.

	2004		2010	
Age (years)	53.5		51.1	
Gender	Male	53%	Male	52%
	Female	47%	Female	48%
Length of residence (years)	18.2		25.1	
Knowledge of places on KI (self-identified)	Excellent	17%	Excellent	24%
	Good	60%	Good	52%
	Fair	23%	Average	23%
	Poor	1%	Below average	1%
Knowledge of places on KI compared with others (self-identified)	N/A		Much more	3%
	More	21%	More	33%
	Same	55%	Same	52%
	Less	21%	Less	12%
	No opinion	3%		

rural residential development (including holiday homes), preference for the future number of KI visitors and confidence in the KI development assessment process (including KI Council) to approve only those projects in the best interest of KI. The item responses were cross-tabulated for each study, and the chi-square statistics were calculated to determine whether the responses were longitudinally similar or dissimilar.

Changes in tourism development location preferences

In order to measure changes in tourism development location preferences between 2004 and 2010, we compared the spatial distributions of markers placed by respondents by using kernel density "hotspot" analysis and the phi-coefficient (φ) statistics to measure the strength of relationship (explanation following). In the 2004 study, participants were requested to identify the spatial locations of tourism development preferences by placing mnemonically coded sticker dots on a paper-map provided with the survey. There were two types of markers associated with tourism development: (1) Places where all future development, including tourism development, should be prohibited, and (2) places where tourism development could conditionally occur with a good plan. The development preference locations were digitized using ArcView GIS software. A total of 391 maps were returned in 2004 yielding 1539 point-locations for tourism development and 1576 point-locations for no development.

In the 2010 study, participants were instructed to drag and drop development preference markers onto a Google Maps image of KI. There were three types of markers that favored future tourism development (tourism accommodation, tourism services and campgrounds) and three types of markers opposing new tourism development (no tourism accommodation, no tourism services and no development of any type). The pro-tourism development markers were combined yielding 761 point-locations and the no tourism development markers were combined to yield 364 point-locations for analysis.

For the 2004 and 2010 point data, we generated kernel density maps using 1000-m grid cell size and 3000-m search radius for each of the four point distributions: 2004 tourism development, 2004 no development, 2010 tourism development and 2010 no development. Kernel density mapping is a technique that fits a smoothly curved surface (grid) over each

Table 2. Responses to development and tourism survey questions in 2004 and 2010.

Survey item	2004	2010	Significance
(a) What type of development is most likely to contribute to the island's future economic prosperity and community well-being?	($n = 423$)	($n = 85$)	
Tourism	51.8	45.9	
Agriculture	16.8	17.6	
Residential	10.9	7.1	
Commercial/retail	8.3	8.2	
Industrial	6.1	4.7	
No development	N/A	5.9	
Others	6.1	10.6	$\chi^2 = 3.70, p = 0.594$
(b) How would you describe the current level of non-coastal rural living residential development (including holiday homes) on KI?	($n = 430$)	($n = 87$)	
Not enough	21.2	25.3	
About right	58.4	55.2	
Too much	13.7	12.6	
No opinion	6.7	6.9	$\chi^2 = .76, p = 0.860$
(c) How would you describe the current level of coastal residential development (including holiday homes) on KI?	($n = 430$)	($n = 86$)	
Not enough	10.7	14.0	
About right	50.5	41.9	
Too much	35.8	41.9	
No opinion	3.0	2.3	$\chi^2 = 2.59, p = 0.459$
(d) What would be your personal preference for the future number of KI visitors?	($n = 432$)	($n = 87$)	
Fast growth (5% annual change)	14.8	20.7	
Slow growth (+1% annual change)	48.4	44.8	
Steady state (0% annual change)	27.8	27.6	
Slow decline (1% change)	4.9	5.7	
Fast decline (−5% change)	1.6	1.1	
No preference	2.5	N/A	$\chi^2 = 1.91, p = 0.752$
(e) What level of confidence do you have in the KI assessment review process (including KI Council) to approve only those development projects in the best interest of KI?	($n = 434$)	($n = 87$)	
Very high confidence	1.2	3.4	
High confidence	4.1	3.4	
Moderate confidence	27.4	29.9	
Low confidence	31.3	34.5	
Very low confidence	21.2	27.6	
Not familiar enough (2004)/no opinion (2010)	14.7	1.1	$\chi^2 = 15.03, p = 0.010$

point producing a circular area (kernel) of a certain bandwidth (or search radius). The resulting highest densities of grid cells are commonly referred to as "hotspots". Since the number of points influences the kernel density calculations, we used standardized kernel densities derived by subtracting the mean grid density and dividing by the grid standard deviation. By heuristic convention (see Alessa, Kliskey, & Brown, 2008; Brown & Pullar, 2012), we classified standardized kernel density values in the top 33% as hotspots.

To measure the degree of association between the spatial distributions in 2004 and 2010, we first clipped each density grid to the shape of KI buffered to 2 km. This eliminated the potential statistical influence of zero grid cell values associated with water surrounding the irregular-shaped island. We then calculated the phi correlation coefficient for each pair of development distributions using data from a 2×2 contingency table where cell values represent the presence or absence of a standardized grid hotspot in the same map location. The phi-coefficient is a variation of the Pearson correlation coefficient that is used for binary data and is related to the chi-square statistic (χ^2), where $\chi^2 = \mathrm{n}\ \varphi^2$ (Chedzoy, 2006; Zhu, Pfueller, & Whitelaw, 2010). The phi-coefficient measures the strength of the relationship on a scale from 0 to 1, and the statistical significance of the relationship can be evaluated with the chi-square statistic. We measured four pairs of relationships: between tourism development and no development in both 2004 and 2010; changes in tourism development preferences between 2004 and 2010 and changes in no development preferences between 2004 and 2010.

To visualize the greatest potential for tourism development conflict, we overlayed the tourism development and no development density maps in 2004 and 2010. The potential for conflict was operationalized as locations where tourism development hotspots spatially coincide with no development hotspots.

To visualize the most preferred future tourism development locations that adjust for no development preferences, we created a composite map by algebraically subtracting the 2010 no tourism development preferences density map from the 2010 preferred tourism development density map. The mathematical difference constitutes a simple "development index" that ranges on a continuum from acceptable tourism development preferences (positive values) to "no development" preferences (negative values). Where tourism development density values remain highly positive, tourism development would be preferred in these locations and where density values go highly negative, no tourism development is preferred. Where density values are near zero, the locations either show no strong tourism development preferences either way, or the development preferences are counterbalancing. A decision rule can be adopted about the resident acceptability of future development proposals in particular areas based on the development index values.

As an alternative to the tourism development index, we also calculated a "tourism development ratio" defined simply as the number of positive tourism development preferences divided by total preferences within a given area. This ratio is especially useful for examining the composition of development preferences within existing land use zones. A ratio of 1.0 would indicate all positive tourism development preferences in the zone, while a ratio of less than 0.5 would indicate more "no development" preferences than tourism development preferences in the zone. As a heuristic, areas or zones with ratios above 0.75 would likely be less controversial with respect to proposed tourism development, whereas conflict should be expected for proposed development in areas with a ratio of less than 0.5.

We analyzed the distribution of preferences using the tourism development ratio for the current zoning designations in the KI Development Plan (Government of SA, 2011) to determine the general consistency of tourism development preferences with existing land use zones. The KI Development Plan contains zones that range from protective zones

with environmental constraints for development such as "coastal" and "conservation" to much more permissive zones such as "tourism accommodation" and "holiday house". The tourism development ratio was calculated for each zone with more than five development preferences. We generated a color-coded map based on tourism development ratios in each zone.

Results

Response rate and respondent characteristics

Out of the 976 letters mailed in 2010, there were 115 full or partial responses yielding 3862 point-locations for analysis. A full response is an individual that maps one or more point-locations and completes the survey questions at the end ($n = 87$), and a partial response ($n = 28$) is an individual that maps one or more locations but does not answer the survey questions following the mapping activity. After accounting for non-deliverable letters ($n = 709$), the 2010 Internet-based PPGIS response rate was 16.2%. By way of comparison, the 2004 paper-based PPGIS response rate was 47%. The mapping response rate, defined as the proportion of those that do the mapping activity compared with the overall response rate, was 76% in 2010 compared with 91% in 2004.

The smaller sample achieved in 2010 compared with 2004 was to be expected given six years had elapsed since respondents had been contacted. The normal attrition problem in longitudinal research was exacerbated in this study by a change in the postal address system of KI, which meant many previous addresses were no longer valid. The relatively low response rate in this study was actually higher than other recent web-based PPGIS studies reporting less than 10% response (see Pocewicz, Nielsen-Pincus, Brown, & Schnitzer, 2012). Nonetheless, participation rate remains a critical future challenge for the PPGIS research.

Respondent characteristics in 2004 and 2010 are presented in Table 1 and indicate a high degree of similarity. Respondents were similar in average age, gender proportion, self-identified knowledge of places on KI and knowledge of places on KI when self-compared to others. The 2010 respondents have lived on KI longer than the 2004 respondents, but this is to be expected given that we estimate over half of the 2010 respondents who were the same individuals that participated in 2004 based on matching responses to socio-demographic questions.

Changes in tourism and development preferences

The 2010 responses to survey items replicated from the 2004 study showed relatively little change in respondents' opinions on development and tourism growth (see Table 2). Despite a 6% drop since 2004, almost half of KI residents continue to believe in 2010 that tourism is most likely to contribute to the island's future economic prosperity ($\chi^2 = 3.7, p > 0.05$). Residents also continue to believe that the current level of rural residential development in both coastal and non-coastal areas is about right, although there was somewhat more polarization in the 2010 responses for coastal residential development (including holiday homes) with about 9% of the responses shifting to either "not enough" (3.3% change) or "too much" (6.1% change). With respect to the preferred growth rate for the number of visitors to KI, there was no overall difference between 2004 and 2010 ($\chi^2 = 1.91, p > 0.05$) with the most responses for a 1% annual growth rate. The small shift in the percent preferring fast growth (5%) may be partially explained by the dropping of the "no preference" option

in 2010. For context, the average annual growth rate in visitation between 2003 and 2009 was about 3.5%. Finally, the majority of KI residents (62%) continue to express "very low" or "low" confidence in the assessment review process for approval of development projects that are in the best interest of KI.

Changes in tourism development location preferences

Statistical tests for spatial associations for tourism development and no development preferences appear in Table 3. The preferred locations for tourism development in 2004 and 2010 demonstrate strong spatial association with significant overlap in density hotspots ($\varphi = 0.56$, $p < 0.001$). Respondents identified many of the same tourism development locations in 2004 and 2010, which can be seen visually by comparing Figures 3a and 3b. However, there are additional tourism development hotspots evident in 2010 (Figure 3b) in the west and both north and south coastal areas that were not present in 2004. These changes between 2004 and 2010 are visually identifiable in Figure 3c as a darker shade (blue on color map).

The preferred locations for no new tourism development in 2004 and 2010 also demonstrate strong spatial association with significant overlap in density hotspots ($\varphi = 0.47$, $p < 0.001$). This relationship can be visually seen by comparing Figures 3d and 3e. The

Table 3. Spatial overlap analysis of preferred tourism development and no development locations: (a) change in preferred tourism development locations between 2004 and 2010; (b) change in preferred no development locations between 2004 and 2010; (c) relationship between tourism development and no development locations in 2004; (d) relationship between tourism development and no development locations in 2010.

(a) Tourism development change 2004–2010	2004				
	Presence	Absence	φ	χ^2	Significance
2010					
Presence	310	435	0.557844	1658.96	$p < 0.0001$
Absence	52	4534			
(b) No development change 2004–2010	2004				
	Presence	Absence	φ	χ^2	Significance
2010					
Presence	689	554	0.473696	1195.99	$p < 0.0001$
Absence	412	3675			
(c) 2004 tourism development and no development overlap	2004				
	No development				
	Presence	Absence	φ	χ^2	Significance
2004 tourism development					
Presence	136	226	0.112767	67.78	$p < 0.0001$
Absence	965	4003			
(d) 2010 tourism development and no development overlap	2010				
	No development				
	Presence	Absence	φ	χ^2	Significance
2010 tourism development					
Presence	291	454	0.149849	119.71	$p < 0.0001$
Absence	953	3633			

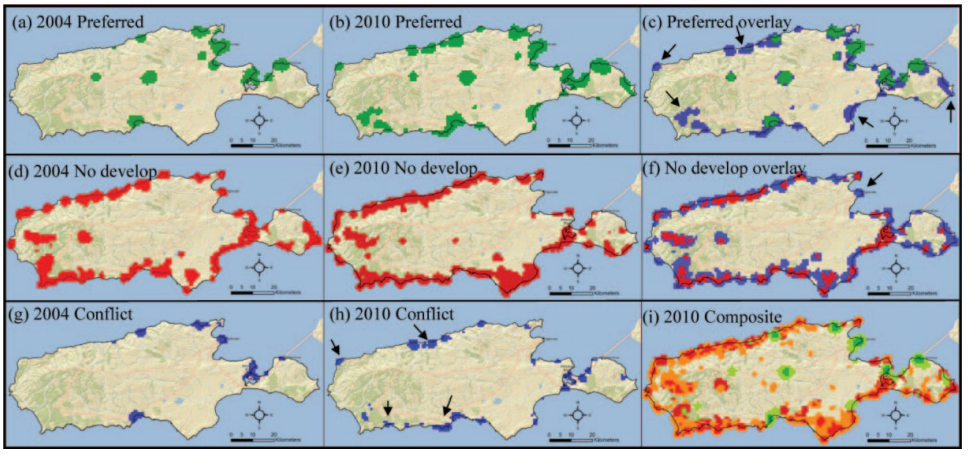

Figure 3. Preferred tourism development locations: (a) in 2004; (b) in 2010; and (c) combined with darker shading indicating new locations in 2010. No development preferences: (d) in 2004; (e) in 2010; and (f) combined with darker shading showing changes. Locations of preference conflict where tourism development hotspots are spatially coincident with no development hotspots: (g) in 2004; (h) in 2010. A composite 2010 map (i) showing development preferences ranging from positive (light) to negative (dark). Source: Author.

changes from 2004 to 2010 appear in Figure 3f as a darker shade (blue on color map). In contrast to tourism development preferences, many of the changes in no development preferences in 2010 appear to be the result of an increase or decrease of area of concern within the same location, rather than entirely different locations. One notable exception to this generalization is the largest town of Kingscote in the northeast, which was a no development hotspot in 2004 but not in 2010.

The spatial associations between tourism development and no development preferences in 2004 ($\varphi = 0.11, p < 0.001$) and 2010 ($\varphi = 0.15, p < 0.001$) are much weaker, indicating that respondents are spatially differentiating between areas on KI where tourism development is appropriate or not appropriate. In other words, there is a significant degree of spatial discrimination or preferential zoning where tourism development appears appropriate or not appropriate. As a generalization, tourism development is appropriate in most existing KI townships, while coastal areas outside the townships are not viewed favorably for new tourism development. There are areas where these spatial preferences overlap, indicating areas with the greatest potential for tourism development conflict (Figures 3g and 3h). In 2004, the potential conflict areas centered on the towns of Kingcote, Emu Bay, American River and the coastal areas of Vivonne Bay (south) and Stokes Bay (north) (Figure 3g). In 2010, the conflict areas have expanded to new coastal areas in the north and south, and to the west where exist the corpus of conservation areas on KI (see arrows in Figure 3h).

The composite map (Figure 3i) combines tourism development preferences with no development preferences through a simple tourism development index. The strongest preferred areas for tourism development appear in lighter shades (greens on color map) and the strongest preferences for no tourism development appear in darker shades (reds on color map). As in 2004, no tourism development preferences in 2010 span most of the island's coastline. Exceptions to the general preference for coastal protection occur in discrete and visually obvious places such as the coastal communities of Kingscote, Penneshaw, American River, Emu Bay, Stokes Bay, Vivonne Bay and the interior community of Pardana.

Positive tourism development preferences are located outside existing conservation park locations, while some of the most negative values are located inside conservation areas. Interior areas of the island are largely tourism development neutral (index values near zero) with few preferences being expressed for these areas. These areas are currently used primarily for agriculture. The most significant change in 2010 is the expansion of tourism development preferences to areas in closer proximity to Flinders Chase National Park on the island's west end where tourism development index values have become positive. These results are indicative of potential conflict over future tourism development in these areas.

Consistency with land use controls

In order to determine the consistency of tourism development preferences with the current zoning scheme on KI, we calculated the ratio of positive tourism development preference points to the total number of preference points in each zone. The resulting ratios were categorized and color-coded for each zone with the results appearing in Figure 4. Zones with ratios above 0.5 indicate more positive tourism development preferences than no development preferences in the zone (lighter shades or green/yellow on color map), while ratios less than 0.5 indicate more no development preferences in the zone (darker shade or red on color map). The map indicates (with arrows) a number of zones with tourism development ratios above 0.5 (more positive tourism development preferences) but which have environmental constraints on development; these zoning classifications are "conservation", "coastal conservation" and "water protection". These zones are located in coastal areas to the south and east and in the large "water protection" zone in the west. These areas suggest greater potential for future tourism development conflict because resident preferences appear inconsistent with the existing zoning controls.

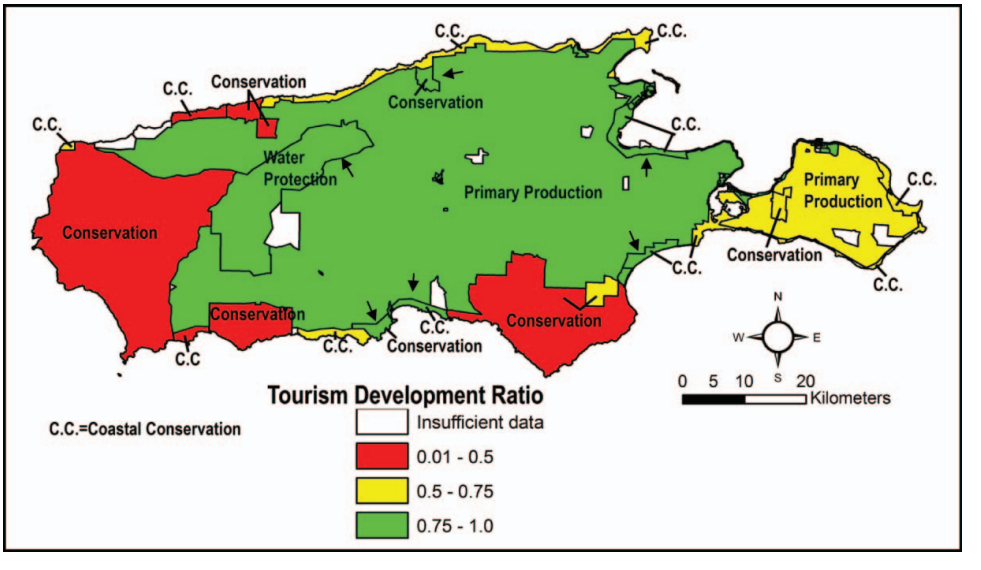

Figure 4. KI Development Plan zones (2011), color-coded with the ratio of positive tourism development preferences to total development preferences. Where ratio is less than 0.5, no tourism development preferences exceed pro-tourism development preferences. Source: Author.

Discussion

The substantive results of this monitoring study indicate general stability in the tourism development preferences of KI residents in the period 2004–2010, both in the non-spatial survey items and in the PPGIS mapped attributes. The spatial results, however, are suggestive of a shift toward greater acceptance of tourism development as a more viable option in the western reach of the island near Flinders Chase National Park. KI residents appear divided on whether tourism development should increase in this area and development proposals similar to the Southern Ocean Resort in Hansen Bay are likely be controversial. An important distinction, however, is that a tourism accommodation zone is provided for this area in the KI Development Plan (Government of SA, 2011) just outside and to the east of the conservation zone containing the national park. The results indicate some residents would advocate development inside the conservation zone, not just in the tourism accommodation zone. Development proposals in this area would be more contested than those in the gateway zone outside the park.

Is the Internet-based PPGIS method an effective tool for tourism development planning and monitoring? We believe so on the basis of the following arguments:

Place matters

Resident acceptance of the costs of tourism vis-à-vis the benefits is not a simple argument about more or less tourism development, but *where* development is appropriate. The opposition to tourism development on KI comes from residents wanting to protect place-specific values for particular areas of the island. Opposition discourse centers on arguments about the need to protect wilderness, intrinsic, therapeutic, scenic, biological, learning, future or life-sustaining values; these values are spatially coincident with PPGIS preferences for no development (Brown, 2006). Some tourism development proponents argue that development should be physically located to take advantage of proximate recreation, scenic and heritage value attractions (Worboys, Lockwood, & DeLacy, 2005). These arguments are not new to nature-based tourism discourse, but there is a conspiracy of silence within the tourism sector that seeks to avoid asking the tough questions. In the 2004 PPGIS study on KI, the South Australian Tourism Commission, a quasi-governmental tourism promotion agency, agreed to partner with the University of South Australia to provide some financial support for the baseline PPGIS study. When the agency learned that the PPGIS study would ask residents about *where* tourism development was appropriate on the island, the agency withdrew support. We speculate that the PPGIS data appear threatening because of the potential to legitimize public opposition to development applications in a process that has historically favored expert and insider access.

Cost-effectiveness

The baseline study completed in 2004 required significant effort and expense using paper-based PPGIS and achieved a reasonable response rate. The 2010 Internet-based PPGIS response rate was significantly lower but consistent with other studies that show lower response rates for Internet-based PPGIS studies (Brown & Reed, 2009; Brown, Montag, & Lyon, 2012; Pocewicz et al., 2012). The response rate was also consistent with the 2009–2010 response rate for the TOMM resident telephone survey (21%).

Age, gender and self-reported knowledge of places on KI were not significantly different from the 2004 paper-based study to the 2010 Internet-based study (Table 1). However, we

acknowledge that an online approach to PPGIS could introduce participation bias that is masked by the similarity of demographics presented in Table 1. This bias could result from the "digital divide" in Australia relating to Internet access and use. Approximately 76% of households in South Australia had access to the Internet in 2010–2011 (Australian Bureau of Statistics, 2011). The data indicate that the lowest income group in Australia ($40,000 or less) is less likely (72%) to have accessed the Internet in 2010–2011 compared with other higher income groups (89% to 97%). Similarly, those 65 years or older or those with less formal education are less likely to have accessed the Internet in 2010–2011 than other age or education census groups. An additional limitation relates to computer literacy (Harris & Dersch, 1999), especially for a more complex survey such as a PPGIS survey. However, in line with the recommendations made by Wright (2005), contact details, including a phone number and post box, were provided to all residents invited to complete the PPGIS survey and only eight people called to say that they had difficulties completing the survey.

When considering the total cost per respondent, the Internet-based PPGIS study was implemented for about one-third of the cost of the paper-based PPGIS. If PPGIS were implemented as a tourism monitoring methodology, it is imperative to achieve high participation rates in the baseline study. A mixed-methods approach that includes a paper-based PPGIS option is recommended. It should also be acknowledged that a close community such as KI that has been surveyed regularly on an annual basis since 2000 is likely to be very discerning when choosing whether or not to respond to surveys and will require a method that is convenient and intuitive, but also clearly strategic in its outlook.

Trust in local government

The 2010 study results continue to affirm that KI residents lack trust in their local government to make development decisions that are in the Island's best interests. The general survey responses indicate that a majority of KI residents are supportive of growth in tourism visitation. The local Council can logically argue that tourism development proposals need to be approved to support the growth given the favorable disposition of the resident population. And yet, favorable attitudes toward tourism growth do not translate into place-specific public assent to tourism development. The PPGIS results presented herein indicate that virtually any coastal development proposal outside major island townships, or located within existing conservation parks, will likely meet considerable resident opposition. We argue that the PPGIS data containing development preferences can and should act as a check and balance on local government in the development review process, especially until the level of trust in local government increases.

Tighter coupling of tourism development with land use planning

The 2010 results indicate that resident tourism development preferences are generally consistent with the zoning controls contained in the KI Development Plan in the west but there are exceptions in the coastal areas. Traditional land use planning partitions a landscape into different zoning classifications under the assumption that the potential for conflict is reduced by spatially separating incompatible land uses (e.g., industrial and residential land use) and clustering complementary land uses (e.g., residential and recreation land use). Land use zoning designations are a useful guide for future development but are frequently vulnerable to development pressure. Zoning change proposals frequently accompany tourism development proposals or in the recent case of the Southern Ocean Lodge on KI, protective zoning designations can be "trumped" by appeal to higher levels

of state government. To avoid retrenchment on zoning designed to protect environmental assets, there is a need to provide ongoing evidence for local support of development controls. The PPGIS methodology is consistent with best practices in land use planning because it explicitly assesses the social suitability of proposed tourism development. The method provides legitimacy to land use decisions that are grounded in the "silent majority" rather than the often-narrow set of development interests that may or may not approximate the public interest. It should also be noted that while attention has been paid to increasing social indicators in TOMM, all three indicators related to public input into tourism management (proportion of residents who believe that tourism development is occurring in line with community values; proportion of residents who indicate they take the opportunity to have input into the direction of tourism on KI when possible; proportion of visitors who identify that they have sufficient information available to be well informed regarding the direction of tourism on KI) were assessed as being below the desired thresholds (Colmar Brunton, 2010), suggesting a need to change the current process and consider measuring development preferences directly rather than assessing quasi-measures of development preferences.

Conclusion

The uptake of PPGIS methods by government or quasi-government agencies has been slow for a variety of reasons, including uncertainty about how to integrate place-based public participation information with the reserved statutory authority for land use decisions. Tourism development decisions can be contentious, and local governments and planning agencies rightfully fear inviting more conflict with a PPGIS process that may be perceived as needlessly inviting NIMBYism. Our experience with PPGIS indicates this fear is unwarranted. Individuals that participate in the PPGIS process approach the mapping activity earnestly and empirical results indicate that the results are thoughtful and representative of the broad range of community views toward future development.

Arguably, the greatest opportunity for PPGIS methods to be systematically included in tourism development decisions is in a location such as KI that is accustomed to being part of an ongoing tourism monitoring program (e.g., over 95% of survey respondents had heard of TOMM). Having developed a cost-effective, web-based system that KI residents seemed to understand intuitively via the Google® interface, it would not be a large step to include spatial measures in the TOMM monitoring process for both residents and visitors. The TOMM process would benefit from more targeted information that can plug into local government decision-making. For example, only 31% of respondents indicated they were satisfied or very satisfied with TOMM's tourism indicators. In the words of several study respondents, "the information collection process is good – it needs to be more readily factored into decision-making with respect to inappropriate development" and "[TOMM] needs to directly relate to community concerns – e.g., coastal development". We believe the collection of tourism development preferences through PPGIS would provide the type of information that would better guide tourism development by establishing closer linkage to the land use decisions that affect the quality of the tourism destination resource and quality of life for residents.

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