ARTICLE

Making Maps That Matter: Situating GIS within Community Conversations about Changing Landscapes

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ABSTRACT

Geospatial analysis and mapping has tremendous potential to inform community-scale deliberations about land use and growth management, but that potential is rarely realized. This article introduces an iterative, participatory research approach to generating maps about landscape change and development trends rooted in local experiences of place and therefore well positioned to contribute to civic dialogue and action. The research process involved collaboration with community partners; ethnographic interviews to identify salient local issues and perspectives; geospatial analysis, mapping, and visualizations of development trends; focus groups to refine information and imagery for local audiences; and deliberative meetings designed to encourage public discussion. Through a case study from a rapidly growing Southern Appalachian county, we show how this process aided the development of maps and visualizations that were relevant and accessible to local stakeholders, made visible local concerns about landscape change, and increased stakeholders' awareness of landscape-scale processes. We argue that this interdisciplinary approach can help to bridge between critical and analytic GIS traditions, provide a mechanism for integrating research agendas with local policy deliberations, and help foster successful civic dialogues and collective action in communities with histories of contentious debate about land-use planning.

Keywords: participatory research, critical GIS, amenity migration, land-use planning, mapping

RÉSUMÉ

L'analyse et la cartographie géospatiales offrent de bonnes possibilités de contribuer aux débats à l'échelle communautaire sur l'utilisation du territoire et la gestion de sa croissance, mais ce potentiel est rarement exploité. Dans l'article, on présente une méthode de recherche participative itérative permettant de produire des cartes sur l'évolution des paysages et les tendances de développement associées aux expériences locales, et par conséquent bien utile pour favoriser le dialogue et les actions civiles. Le processus de recherche nécessite une collaboration avec les partenaires de la communauté ; des entrevues ethnographiques pour déterminer les perspectives et les problèmes locaux importants ; une analyse géospatiale, une cartographie et une visualisation des tendances en matière de développement ; des groupes de consultation pour préciser les renseignements et l'imagerie pour l'auditoire local ; et des réunions pour favoriser les débats publics. À l'aide d'une étude de cas portant sur une région du sud des Appalaches, on montre comment ce processus a aidé à développer des cartes et des visualisations pertinentes et faciles d'accès pour les intervenants régionaux, et à rendre visible des préoccupations régionales liées au changement du panorama et à sensibiliser davantage les intervenants sur les processus à l'échelle du paysage. On suggère que cette démarche interdisciplinaire peut aider à créer un lien entre les traditions en SIG critique et analytique, et qu'elle fournit un mécanisme visant à intégrer les programmes de recherche et les débats sur les politiques locales. De plus, elle aide à favoriser un débat civique et une action collective profitables pour la planification de l'utilisation du territoire dans les communautés ayant des antécédents de débat litigieux.

Mots clés : recherche participative, SIG critique, migration des commodités, planification de l'usage du territoire, cartographie

I feel like we're giving up a lot in Macon County . . . I mean, I don't know anybody that rabbit hunts anymore. There's no place to go, no place to run your dogs. That used to be a big deal around here. You could go about anywhere you wanted to go, and at least if somebody had seen you on their land hunting, they'd either holler to you to come have a cup of coffee when you get done or something. And now they got these damn yellow No Trespassing signs. I don't know – I think we lose a little bit every day.

—Mike Breedlove (interview, 11 February 2005)

This was an almost completely just local rural area when we came 20 years ago, and you know, you can just see the changes. It's all the new houses – especially in the last say five or so years. The development has been major. We felt like this northern end of the county is much less impacted than some other parts, but it's just, it's coming so fast. I mean, if you had told me 20 years ago that that farm over there could potentially have 30 houses on it, or that this road could have seven – I wouldn't have believed it.

—Susan Ervin (interview, 19 August 2004)

Introduction

In informal conversations in the early 2000s, many residents of Macon County, North Carolina, were voicing profound concerns about the effects of rapid, amenity-driven development on the Southern Appalachian landscape and on local communities. However, these concerns went largely unrepresented in formal policy discussions, where expressing support for growth management had not gained acceptance. In early 2002, for example, a proposed countywide land-use planning process disintegrated without reaching a public hearing, as a result of public distrust and hostility (Cho, Newman, and Bowker 2005; Cumming, Guffey, and Norwood 2008) – the latest in a string of abortive planning initiatives in the county dating back to the 1970s.

In response to the negative ecological and cultural consequences of rapid, unplanned development and the repeated failure of formal public participation procedures to address these problems, a grassroots group, Macon Tomorrow, formed in 2002. Macon Tomorrow, which sought to improve civic engagement in discussions about land-use planning, began collaborating with the authors[1] in 2004. Together, we designed a participatory research project, Little Tennessee Perspectives (LTP), that aimed to promote a more *inclusive*, *informed*, and *ongoing* conversation about land-use change in the community.

This article focuses on the co-production and deployment of landscape analyses in LTP to promote a more *informed* public dialogue. Project organizers believed that previous planning processes had suffered from a lack of accessible information regarding land-use trends of interest; therefore, we sought to generate information that was relevant, accessible, and explicitly situated in community discourse about land-use change. To do this, we developed a participatory research approach that (1) used ethnographic analysis to assess local perspectives on and concerns about the changing landscape, (2) created maps and information graphics that "visibilized" those perspectives/concerns (Wilson, Wouters, and Grammenos 2004) or other key trends in landscape change, and (3) used this information to foster citizen engagement in discussions about growth management.

We argue that this participatory process succeeded in grounding GIS and landscape visualizations in local experiences of a rapidly changing landscape and, in so doing, helped to build civic capacity to address the issues being mapped. In this article, we begin by considering the need to more thoughtfully situate research on land-use change in relation to community discourses and by reviewing critical and feminist prescriptions for improving GIS practice. We then introduce the study site in more detail and describe the iterative, participatory methodology that we developed with community partners. We report the results of each phase and share selected maps and visualizations produced through this iterative process. Our discussion elucidates how the process yielded opportunities for improving mapping and also supported participant empowerment; together, these two outcomes helped to build civic capacity to address the issues being mapped.

Connecting GIS to Communities' Lived Experiences

GIS maps, visualizations, and land-use models produced through conventional analytical approaches are widely regarded as having the potential to inform local discussions of policy/planning (Sanoff 2000; Ceccato and Snickars 2000; Al-Kodmany 2001, 2002; Baker and Landers 2004; Verburg and others 2004; Appleton and Lovett 2003; Nicholson-Cole 2005). Alan MacEachren (1995, 11) urges that "[i]f we accept the premise that maps can 'work,' we have an obligation to facilitate their use." Stephen Sheppard (2005, 648), referring to climate change, has argued that "the persuasive use of visualizations, together with other tools and approaches, is justified if they can be effective, and may even be vital" for encouraging policy responses.

However, geospatial research is not typically well positioned to be referenced by residents of fast-growing communities or by local policy makers (Barrett 2003; Theobald and others 2005; Couclelis 2005; Norwood 2009). Although it is at the local level that most land-use decisions are made (Porter 2008), there has been little research on how models or visualizations actually inform local policy responses (S. Sheppard 2005). Christopher Pettit and others (2011, 232) have observed that relative to the development of visualization techniques, "there is a much

more limited body of work dealing with end user evaluation" of such material.

Macon County provides a particularly striking example of the disconnect described above. Aspects of land-use change in the county and the surrounding region have been thoroughly studied by researchers associated with the Coweeta LTER site in the region (e.g., Wear, Turner, and Flamm 1996; Wear and Bolstad 1998; Gragson and Bolstad 2006). Regional leaders have evinced little familiarity with this research, however, despite its substantive relevance to land-use policy making. For example, interviews with six county planners in the region in 2004 documented that none were acquainted with published academic studies about landscape change in the region. One respondent remarked, "No, academics write for academics … who ever sees it?" Thus, although the ecologically rich landscape of Macon County and the Southern Appalachian region has been the subject of extensive research on land-use change trends and their long-term consequences, that same landscape continues to be degraded by unplanned development and fragmentation.

Critical GIS, which "has emerged at the interface between geographic information science and geographic social theory," offers a theoretical approach to better situating landscape change research in social contexts (E. Sheppard 2005, 5), and thereby potentially facilitating its integration into discussions about how to manage the landscapes that are being represented. Critical GIS considers the "impacts of GIS technologies on people" by raising questions of representation, hierarchy, context, and reflexivity (Harvey, Kwan, and Pavlovskaya 2005, 1). In practice, however, critical GIS and conventional, analytical GIS have not often been integrated (Schuurman 2000; Kwan 2002; Williams and Dunn 2003).

An extensive critical and feminist literature has challenged the epistemological and methodological binaries between critical and analytic approaches to GIS (Knigge and Cope 2006; Kwan 2002, 2004; Kwan and Ding 2008; Pavlovskaya 2006). These scholars have encouraged mixing qualitative and quantitative methods more generally (Tashakkori and Teddlie 1998), delinking methods from epistemologies (Rocheleau 1995; Pavlovskaya 2006), and reimagining "hybrid" linkages between social–cultural and spatial–analytic approaches (Kwan 2004). They assert that GIS is not just a tool of positivist science, citing the nonquantitative roots of GIS and the centrality of visualization as both a means and an end within much spatial analysis; in fact, "similar to other research methods, GIS is neither strictly quantitative nor qualitative but may be meaningfully used in different types of research" (Pavlovskaya 2006, 2010).

Further, GIS offers unique tools that can usefully inform critical inquiry (McLafferty 2002, 2005; Bell and Reed 2004; Pavlovskaya 2006). Kwan (2002, 650) outlines a convincing rationale for including GIS within the toolbox of critical and feminist researchers: it can support feminist activism, help "identify complex relationships across geographical scales," link individual experiences to larger-scale forces, and help construct "different spectator positions" and "new visual practices." Geospatial technologies can be adapted to tell embedded stories of place and personal experience, and offer a "means of storytelling and a technology for self-expression" (Kwan 2007, 25). Drawing on these past bridge-building efforts, the emerging field of critical quantitative geographies seeks to "explore the possibilities for crossing the boundary of and forging creative connections between critical/qualitative and analytical/quantitative geographies" (Kwan and Schwanen 2009, 262). Scholars suggest that fruitful and mutually enriching interactions can occur between GIS and a range of critically motivated research agendas – for example, consideration of how quantitative methods can "take people's lived experience into account" (262).

Despite the increasing recognition of GIS as a technique that can "engage alternate knowledge" (Harris and Harrower 2006, 2), several scholars have identified an ongoing need to increase the relevance of critical research outside the academy (Martin 2001; Pain 2003; Fuller and Kitchin 2004). Rob Kitchin and P.J. Hubbard (1999, 196) admonish that "[i]f critical geography is serious about its (emancipatory) intentions, then it needs to reconceptualize how it can engage (and participate) with marginalized populations, opening new, alternative routes for 'doing' geography." Ways of putting this mandate into practice, reviewed below, include (1) combining GIS with qualitative fieldwork, (2) participatory GIS, and (3) GIS in participatory research.

In a few cases, qualitative field methods and GIS have been used jointly to answer critical questions. Andrea Nightingale's (2003) study of forest change in Nepal, which used interviews and interpretation of aerial photography, illuminates areas of consistency and discrepancy between the two methods. Marianna Pavlovskaya (2002) combined interviews and GIS analysis to map informal economies in Moscow, illustrating that traditional analytic GIS can operate on more contextualized data. "Missing" data describing the social landscapes of fishing communities and fisheries have been mapped and vetted by fishers (St. Martin and Hall-Arber 2008), and remote sensing and ethnography have been combined to study perceptions of cultural landscapes (Jiang 2003). Mapping workshops and narrative have been combined to develop more robust understandings of landscape trajectories (Duncan, Kyle, and Race 2010), and "grounded visualization" has been modelled as a successful approach to integrating GIS and qualitative/ethnographic data in a reflexive and iterative manner (Knigge and Cope 2006).

Participatory GIS (PGIS) provides another means of using GIS for community purposes. PGIS "involves local communities in the creation of information to be fed into the

GIS and subsequently used in spatial decision-making which affects them" (Dunn 2007, 619). Representing a range of practices, the major contributions of PGIS have been to democratize GIS practice by involving more diverse constituents in mapping and to empower grassroots knowledge through GIS production (Harris and Weiner 1998; Craig, Harris, and Weiner 2002). However, critical evaluations have found that PGIS projects "may not be as attentive to issues of access, power relations, and diverse knowledge claims as the critiques of GIS that fostered participatory GIS in the first place" (Elwood 2006, 700). Therefore, it has been suggested that "a GIS which is vested in the interests of the people (as defined by them) through an approach based on GIS in *participatory research* may be more successful and achievable than a truly 'participatory GIS'" (Dunn 2007, 632; emphasis added).

Participatory research (PR) has roots in education, community planning, public health, and natural resource management (Lewin 1948; Freire 1981; Gaventa 1988; Israel and others 2003; Wilmsen 2008). There are many definitions of PR, but Carl Wilmsen (2008, 11) has identified three common characteristics of PR efforts: "the production of knowledge through some formal process … the participation of non-scientists in research processes, and … concern[ed] with social change." PR "involves those conventionally 'researched' in some or all stages of the research, from problem definition through dissemination and action" (Pain 2004, 652). PR, then, offers a range of ways for non-researchers to be involved in generating maps and spatial information, and can be a more comprehensive approach to participation in mapping than PGIS. As opposed to PGIS projects, many of which "do not utilize GIS functionality for advanced spatial analysis" (Craig and others 2002, 11), PR may enable more advanced geospatial analysis to be integrated into community-driven processes.

PR offers several benefits to critically informed mapping. Most fundamentally, it can provide a mechanism for better engaging geospatial technologies with real-world challenges (Schuurman and Kwan 2004). PR is attentive to context and lived experience, and this attention can enrich critical inquiry. And because PR invites external evaluation of scholarly products and processes, it is well suited to encouraging continued reflexivity among critical GIS scholars (E. Sheppard 2005). Finally, in the interdisciplinary, problem-driven context of PR, novel ways of bridging critical and analytical GIS traditions may be revealed. For example, researchers have reconstructed maps and histories of tribal lands among unrecognized American Indian tribes using a GIS-in-PR framework (Middleton 2010).

The present study was conceived not as a PGIS project but as a PR project that combines quantitative GIS with qualitative methods to address community concerns in critical ways. Instead of involving people hands-on in the manipulation and visualization of existing data or building new databases directly from local input, our approach used ethnographic interviews of stakeholders as a source of data on local *values and concerns* that then *set the agenda* for quantitative GIS analyses. Stakeholders were then also empowered to critique the visual presentation of those analyses, participate in conversations about the changes being illustrated, and use the results in a variety of venues. This approach is described in more detail below.

Study Site

The physical and cultural landscape of the Southern Appalachians has witnessed dramatic changes in recent decades. Attracted by the area's natural beauty and rural character, unprecedented numbers of amenity migrants have moved in, bringing new cultural and ecological challenges to a region that has little experience in growth management (Gragson and Bolstad 2006; McGranahan 2008; Culbertson and others 2008). Prior to the housing-market collapse in 2008, Macon County, North Carolina, exemplified this phenomenon. Between 1990 and 2000, the permanent population of the county grew by 26.8%, faster than projected (US Census Bureau 2002). Property values in the county increased nearly 40% between 1999 and 2003, and in recent years seasonal housing units have accounted for more than half of all new residential development (LTLT 2004).

This unprecedented influx of people and development into rural areas has profound implications for environmental quality and for sense of place and quality of life in these communities (Riebsame, Gosnell, and Theobald 1996; Jobes 2000; Hansen and others 2002; Green, Deller, and Marcouiller 2005; Moss 2006). "The frantic pace of land development … has caused the destruction of many amenities that people have long enjoyed and taken for granted" (Healy 1976, 4), such as scenic landscapes and water quality. Eric Freyfogle (2003, 177) describes this as the "tragedy of fragmentation," which "occurs when landscapes are divided into small pieces with no mechanisms available to correct market failures and achieve landscape-scale goals." Because exurban development results in significant fragmentation of landcover, it has implications for habitat connectivity, disturbance regimes, biodiversity, and other ecosystem functions (Theobald, Gosnell, and Riebsame 1996; Turner, Gardner, and O'Neill 2001; Jules and Shahani 2003; Hansen and others 2005; Travis 2007).

The dominant political discourse in Macon County during this period was pro-growth and anti-regulation, while citizens who voiced concerns about the effects of unmanaged growth (including perceived negative impacts on water quality, forest health, cultural heritage, or quality of life) were typically marginalized (McLeod 2001; Johnson 2003a,

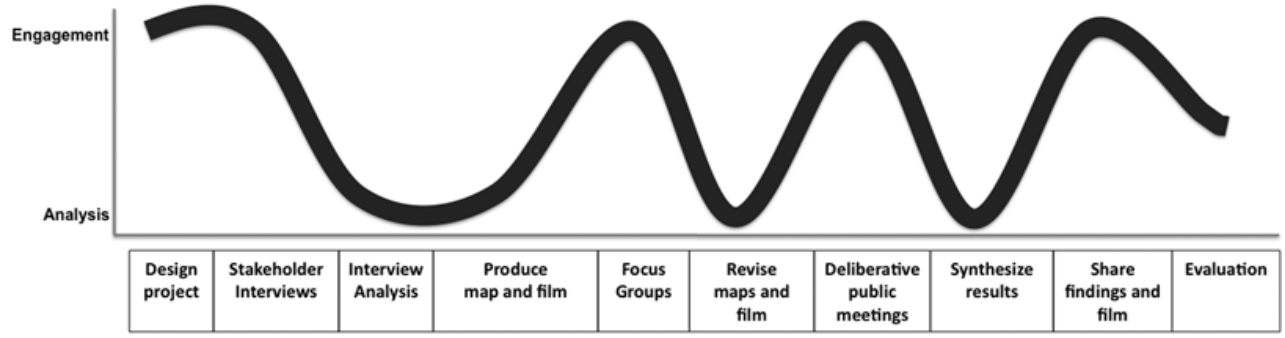

Figure 1. Iterative method employed by LTP.

2003b, 2003c). Illustrating this resistance to planning, in 2002 the county planner had to be accompanied by a deputy to local meetings about the county-wide land use plan due to threats of physical violence (Johnson 2003b). The effect of this discourse on citizen participation was summarized by an interviewee who said,

> I've always had a philosophy, and I've told my children this when I was raising them and I've said this to many politicians: listen to the people who aren't talking. The majority of people don't like to come to public meetings. They don't like public speaking. They're not comfortable, and they're not going to get embroiled in a controversy … And if they're in favour of zoning, they're not going to go … into a room of people that are against it and stand up and be pro. (Wilma Anderson, interview, 15 March 2005)

Using PR to Guide Critically Oriented Geospatial Analysis: The Little Tennessee Perspectives Methodology

It was in this strained and unproductive atmosphere that the Little Tennessee Perspectives (LTP) research project was developed, with the goal of fostering a more inclusive, informed, and ongoing public conversation about the future of the local landscape and community. This article focuses on the use of mapping within the overall project, which also included the production of a documentary video, deliberative public meetings, and evaluation (for more information about the overall method see Cumming 2007; Cumming and others 2008; Norwood 2009; and Cumming and Norwood 2012). A diagram of the entire iterative, participatory methodology is shown in Figure 1.

The project's six phases are described below. Over the course of LTP, these successive phases engaged different stakeholders in different ways, which served to increase the number and range of perspectives included in the project. The iterative process also provided multiple opportunities for residents to assess the accuracy and relevance of our work.

1. *Project Planning:* To represent the perspectives of local residents involved in planning issues and foreground the production of practical maps and analyses that addressed local needs, LTP was developed in collaboration[2] with a grassroots organization, Macon Tomorrow. Our local partners also included the county planner and representatives of the planning board, the local land trust, and a regional environmental organization. This group helped shape the overall research agenda, breaking down the typical divide between researcher and community (Gaventa 1988). Our partners helped to conceive strategy, provided guidance on project planning and logistics, and in some cases served as gatekeepers to others in the community. Once we reached agreement on overall goals, methodology, and timing, we completed the university's review process for human-subjects research.
2. *Ethnographic Research and Interview Analysis:* Using a combination snowball and purposive sampling methodology (Bernard 2002; Patton 2002), we conducted 50 semi-structured interviews with residents of Macon County. Interviewees were recommended by their peers as having an important perspective on the changing landscape. Taken as a group, the interviewees were representative of the demographics of the county; they included long-time landowners, real-estate agents, amenity migrants, advocates of property rights, and conservationists. This format allowed us to elicit views in the relative intimacy of an interview rather than in a contentious public meeting. Interviewees were asked about their connection to the area, their perceptions of change resulting from increases in development (both positive and negative), and their visions for the county's future. Interviews were audio-recorded and transcribed. Using an open coding methodology (Patton 2002) in Atlas/ti software, we identified the most prevalent views expressed, including the most frequently cited concerns about the changing landscape.

3. *Mapping and Geospatial Analysis:* While interviews were being conducted, we also gathered quantitative geospatial data on growth and development from a variety of sources, including county, state, and federal databases. Obviously, these data are biased toward a certain reading of the landscape and serve largely administrative functions (Scott 1998). Despite these constraints on available data, we felt the material would contribute new information to the public conversation about planning and could be used without marginalizing other perspectives on place. The data were imported into ArcGIS 8.1, and routine cleaning and data management tasks were performed. We then began experimenting with how to "map" the most widely shared concerns about the changing landscape, as expressed in the interviews and revealed through the coding. We also created maps, visualizations, and other graphics that took advantage of our more "expert" knowledge of the available data to compare or juxtapose trends in ways that might expand the conversation about land-use planning in the community.
4. Focus *Groups:* To refine the resulting maps, we convened five focus groups of local residents (Langford and McDonagh 2003). Macon residents were recruited through flyers and newspaper ads, and were paid a small stipend for participating in the two-hour meetings.[3] In this phase of the process, the goal was to ensure that the maps and analyses were relevant to local concerns, accurately represented local perspectives, and were clear to a lay audience. Draft maps were projected onto a screen, and participants were asked to critique the maps: Did they understand the information presented? What changes would increase clarity? Was the subject matter relevant and important to their experience in Macon County? We also solicited suggestions for other maps or information that should be added. Based on the feedback we received, as well as comments from partners, the maps were revised.
5. *Deliberative Meetings:* By this stage in the process, we had produced and refined maps about the changing landscape that portrayed widely shared local perspectives on development; now we hoped to insert them into Macon County's civic discourse. Working with our partners, we planned public meetings in four different communities around the county: because of the mountainous terrain, travel times can be a significant barrier to participation, so we chose to conduct multiple meetings to give everyone who wanted to participate a reasonable opportunity to do so. The deliberative meeting format was designed to avoid common problems with public-hearing-style meetings by fostering an atmosphere that would encourage dialogue (Forester 1999; Dryzek 2000; Innes and Booher 2004; Senecah 2004; Cox 2006; Walker 2007; Cumming and Norwood 2012). Each meeting followed the same agenda:
    a. Welcome by a local resident
    b. A 15-minute slideshow of the maps about landscape change trends
    c. A 30-minute documentary video based on the interviews
    d. Facilitated small-group discussions that invited meeting participants to critique the presentation, discuss their visions for the future, and share ideas for enhancing participation in the future
    e. Facilitated full-group discussion in which shared visions and potential next steps were identified
6. *Evaluation:* The meetings were videotaped for later analysis, and quantitative and qualitative feedback was obtained through post-meeting evaluation forms and observation. Based on feedback from meeting participants, we refined the maps further and created a DVD featuring a final version of the land-use change presentation and documentary video. This was shared with interested citizens, decision makers, and other organizations in the area. We also tracked media coverage in two newspapers (one local and one regional) and conducted follow-up interviews with our community partners to evaluate the entire process. Because representativeness is always at issue in participatory research, we also compared the perspectives of meeting participants to those of a random sample of Macon County residents through a mail survey, which was sent to 1800 residents in 2007 and achieved a response rate of 46.8%.[4] Although an in-depth analysis is beyond the scope of this article, the survey found high levels of agreement between LTP participants and survey respondents on key attitudes toward growth and growth management (Cumming 2007). The survey also provided a novel way to further investigate the design and deployment of maps and visualizations about changing landscapes (described in more depth in Norwood 2009).

Results

RESULTS FROM THE INTERVIEWS

Throughout the interview process, we observed that most interviewees were eager to discuss the subject of planning and growth management. Many were appreciative that someone (even a student) wanted to listen to their views on this topic of local importance. Although our goal was

not specifically to focus on marginalized voices, it became clear over the course of the interviews that many people felt they lacked a voice in local planning processes, even if they faced no systemic barriers to participation.

Coding revealed that more than 90% of interviewees believed land-use planning was warranted to manage increasing development in the community. Many lamented the changing pattern of development, including residential building on steep hillside slopes, ridgetops, or floodplains: "I don't like the way that they've carved out our hills and how they've built on our mountain tops." Other major concerns included the influx of wealthy outsiders; the increasing number of part-time residents; loss of farmland; loss of sense of community; and loss of informal commons for hunting and walking. Interviewees had more difficulty identifying positive effects of growth, but commonly cited positive effects included contributions of new in-migrants to the community through civic engagement and volunteerism, as well as increased economic development and shopping options.

RESULTS FROM THE FOCUS GROUPS

Focus groups provided a valuable way to refine the maps and geospatial information about changing landscapes for public consumption. Participant feedback led to clarification of images, prioritization of which types of data should be included in the presentations for the public meetings, and a reduction in technical jargon. Participants favoured maps that included more orienting information, such as towns and roads. For example, even if a series of maps all depicted the same area, participants wanted locations labelled on each one. They also emphasized the need to carefully explain the legend for each map, rather than assuming that the audience would read and understand it on their own; this is a manifestation of the split attention effect (Kalyuga, Chandler, and Sweller 1999). When subcounty maps were used to illustrate a topic, participants preferred to first see a locator map showing the smaller area highlighted on the county map before proceeding to the sub-county image ("show the narrow [view] and then go big – tell them they should be thinking about how they are interconnected.")

Multiple maps illustrating trends were favoured over single maps: for example, maps depicting increasing housing density over time or land subdivision were consistently popular. The rate of growth and land parcelization were of interest to most participants, but we were urged to limit the statistics referenced: "you don't need to know specifics, you just need to get an idea of change from one time to the other." Participants also encouraged the pairing of multiple data sources (e.g., juxtaposition of photographs and maps). Cadastral maps proved almost universally engaging: participants were interested in finding their own properties and then assessing the overall trends in relation to their homes or local community. They were familiar with the unit of the property parcel.

By contrast, grid-based and remotely sensed data commonly used by research scientists studying land-use change elicited more varied reactions. One participant found the landcover data "important – it gives a person the same ability to recognize a situation as a graph does, in no words whatsoever." But approximately half the participants found these data confusing. In response to a map of classified Landsat data depicting landcover changes, one participant observed, was "not interesting to the average person … who are you gearing this towards? … I don't think that makes sense." We opted to remove much of this imagery from the final presentation,[5] but we made it available to those who might be interested in another way, by creating posters that were displayed in the meeting rooms. Focus-group participants' negative reaction to raster data could be due to scale mismatch (Theobald and others 2005), unfamiliarity with the format (raster vs. polygon data), or the way the maps were explained. We also removed a fly-through video of parcelization because participants did not find that the animation enhanced the clarity of the information (Harrower 2007). Maps were also added to the presentation, including a map indicating the location of Peeks Creek, a significant local site where a 2004 landslide killed four people.

FROM INTERVIEWS TO MAPS: TWO EXAMPLES

The following two examples illustrate how widely shared concerns identified from interviews were used to guide geospatial analysis and map production. In each case, an exemplar quote from the interview data has been selected to convey the concern that the subsequent maps were developed to address.

(1) Changing Pattern of Development: Building on the Mountains

> *If we don't do something, every one of our mountains is going to be the same. I told my grandson, I said, you better go ahead and take some pictures of these mountains right now while there's not a house on every one of them.*
>
> —Claudette Dillard (interview, 4 April 2005)

Vacation homes have been built in the region for many decades, but these homes initially tended to be small and relatively unobtrusive. Homes constructed during the most recent wave of development, beginning in the 1990s, have typically been larger, more visible, and located at higher elevations. One interviewee observed that "it used to be that people who came here came because they loved the mountains, and they wanted a mountain cabin … and now I'm seeing more and more of the bigger houses." An analysis of house location data found that the average elevation of homes built in the 2000s surpassed the average

elevation of homes built before 1950 by 85 m. Nonetheless, as of 2005 there were no regulations restricting the subdivision and development of rural land in Macon County, including development on steep slopes or ridges.

The deep and widespread concern about unmanaged development on steep slopes and ridges expressed in interviews led us to develop maps and infographics to illustrate these trends and to encourage residents to think about the longer-term outcomes of unplanned development on the mountainsides. A viewshed analysis laid the groundwork for a series of maps and visualizations that proved quite resonant with these concerns. A viewshed analysis calculates what is visible from an input feature, often a single point (e.g., the top of a hill or a local landmark), based on line-of-sight calculations using a digital elevation model (DEM; Fisher 1996). Cumulative viewshed analysis calculates what areas are visible from multiple points, rather than a single point, and has been used in archaeological studies to examine whether different archaeological sites were visible from each other (Wheatley 1994).

In this case, a cumulative viewshed surface was calculated for the whole county, using ArcInfo's *vshed* function.[6] This computationally intensive process took three weeks and produced a grid of the entire county that reflected the number of times each 30-m cell of a DEM could be seen from thousands of points along the road network. This layer, representing the *community viewshed*, is shown in Figure 2. By identifying places in the county that were cumulatively most visible from the roads, it served as a good approximation of the places likely to be most visible to the most people. Overlaying the US Forest Service and current property boundary layers onto the community viewshed layer revealed that only a small proportion of the county was both privately owned and in the most highly visible class:[7] just 3.5% of the county fell into the most visible class, and only one-third of that was privately owned. The viewshed map, then, offered a means of focusing other analyses, including examinations of subdivision patterns, on these highly visible areas – a novel use of viewshed analysis.

The general accuracy of the analysis was verified with community partners and through field observations. By conferring with our partners, we determined that the concept of *viewshed* was not in general use locally and would be appropriate to introduce. Through comments from focus-group participants, the clarity of the viewshed map was improved by showing and labelling the incorporated towns and adding the Nantahala National Forest ownership layer to make it clear which parts of the county were privately owned. In addition to increasing the clarity of this map, the focus groups also provided an opportunity to workshop a series of images exploring steep-slope development in highly visible areas. Figure 3 depicts the already-subdivided portions of the most highly visible of the privately owned hillsides in the county – a development that had been mentioned explicitly in several interviews. This image was developed in ArcScene, a 3D mapping program, to illustrate parcelization and potential development from a more natural perspective. This image, however, was not very engaging for focus-group participants. As a result of their comments, we generated the photo-based image shown in Figure 4,[8] which used an actual photograph to illustrate the same point, but proved to be more popular.

(2) High Degree of Non-local/Out-of-State Property Ownership

> *Over these 50 years, I should say there's been a tremendous growth in Macon County, and as a result of that, there's been a lot of people moved in, and there's actually more people living in Macon County today that came from somewhere else than there are native people.*
>
> —Bill Fouts (interview, 9 March 2005)

> *I knew every person up this road . . . I knew every person, every household. Now up this same road, I don't know probably 50%. I could show you the old homeplaces . . . but there's a lot of places that I could not tell you who lived there now.*
>
> —Charlie Dowdle (interview, 20 January 2005)

> *The local people feel threatened by the suburbanization and the second home development and all that.*
>
> —Bill Crawford (interview, 20 August 2004)

Another common concern among interviewees was the influx of part-time residents, irrespective of the location of their homes on the landscape. We explored this concern by analysing the county parcel database[9] to determine the proportion of parcels and of acreage in the county owned by non-residents. For this analysis, a *local resident* was defined as one whose tax bills went to an address within the county, and a *non-resident* as one whose tax bills went elsewhere. Analysis revealed that 43% of the properties in the county, representing 38% of private acreage, were owned by people who lived full-time outside the county. Further analysis revealed that 24% of the parcels in the county were owned by full-time residents of Florida. Figure 5, below, shows the distribution of parcel ownership by state; Figure 6 depicts land-ownership patterns by parcel in Cowee Township, located in northern Macon County. In both cases, full-time residents who have migrated to the county are indistinguishable from long-time residents; in this way, the parcel database masks a locally salient attribute of land ownership.

RESULTS FROM LTP MEETINGS

The four LTP meetings attracted a total of 170 participants; they were considered by project organizers to be well attended. The meetings were marked by engaged

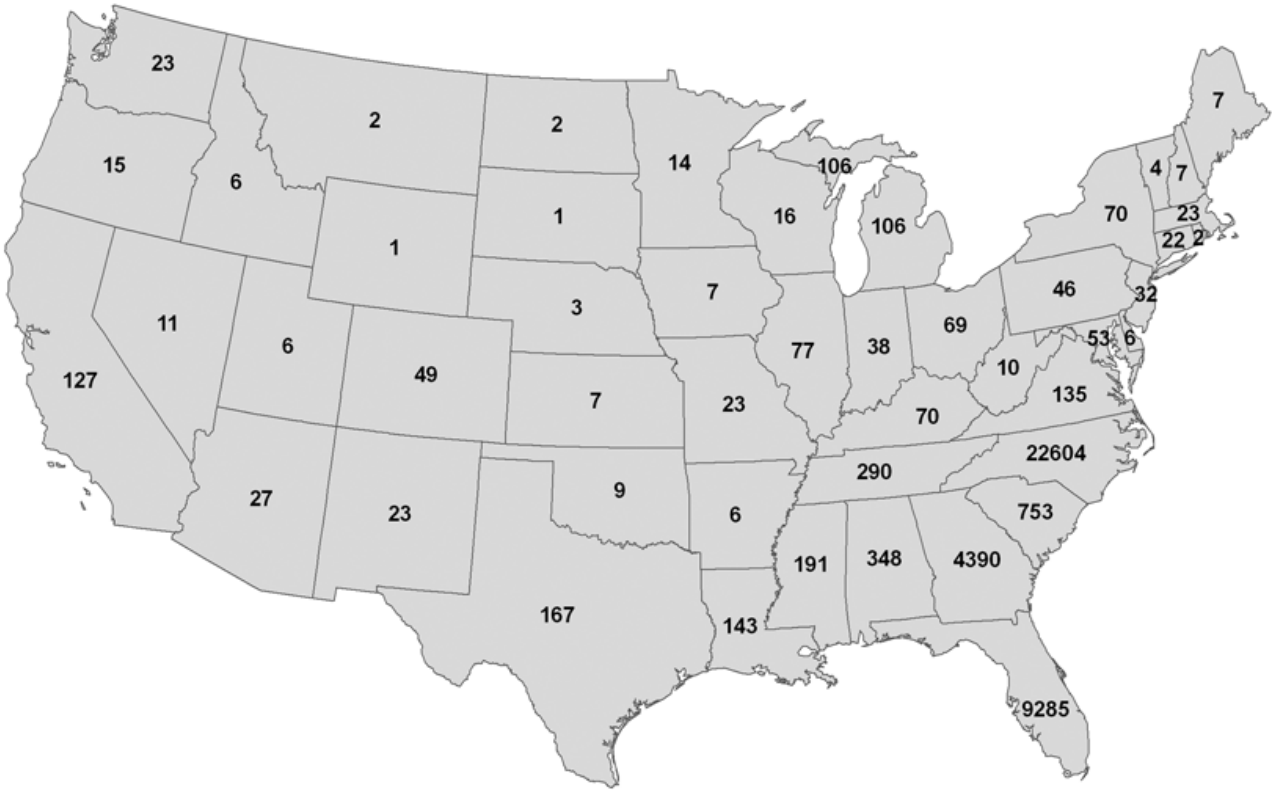

Figure 5. Number of Macon County Parcels owned by full-time residents of each state, 2005.

discussion and a generally positive atmosphere – a sharp contrast to previous meetings about land use in the county, which had tended to be loud, antagonistic, and full of bullying rhetoric. The deliberative format and small-group discussions afforded all participants the chance to speak and encouraged a productive, fair, and respectful dialogue. Many participants were visibly excited to have information presented that was relevant to their experiences and reflected their concerns. Little time was spent complaining about the changes to their community or summarizing what was wrong, as often happens in public meetings; instead, the information presented, along with the meeting format, equipped participants to move forward and embark on a new type of discussion: one focused on how the community could deal with the changes that were happening.

Data from evaluation forms, completed by 48% meeting participants,[10] substantiate our observations about the meetings; they indicate that the iterative, participatory methodology we employed produced images that enjoyed a high degree of salience in the community. Based on evaluation forms, 100% of attendees found the geospatial information presented relevant and interesting, while 97% found the information understandable. Just over 91% reported that they learned something new, most commonly about the *rate* of growth. One meeting participant offered the comment that residents were "hungry for data" about how their community was changing. Others commented that the maps provided "relevant information – a chance for opening a dialogue," and noted the "the power of projected growth." It is analytically impossible to completely separate out the impacts of the different meeting components, but the entire process, including the mapping presentation, documentary video, and small-group discussions, was overwhelmingly considered a "good vehicle for community discussion," as one participant noted. Our experience suggests that the qualitative–quantitative approach, which combined the documentary video (composed entirely of local interviewees reflecting on the changes they saw and their hopes for the future) with the presentation of the maps and geospatial analysis, was an unexpected and powerful combination.

RESULTS AFTER THE MEETINGS: EFFECTS OF COMMUNITY-ORIENTED MAPS ON THE DISCOURSE AND PRACTICE OF LAND-USE PLANNING

Both the products (maps, statistics, analyses) and the process (iterative, grounded, participatory) of LTP have been influential in the period since the public meetings in August 2005. The products have continued to be used and referenced by community residents, area non-profits, and local governments. Statistics on growth and development generated through the project have been cited in three local newspaper editorials calling for growth management:

one, titled "Thoughtful Conversation Starter" (2005), observed that "the statistics and data projections add compelling evidence of the scope of change happening all around us." The project itself has been the subject of at least 12 newspaper articles; this degree of coverage suggests that LTP succeeded in producing relevant, understandable information about an issue of local importance.

In addition, information produced by LTP has contributed to grassroots organizing in favour of more growth management: statistics, maps, visualizations, and photographs from this research have been used to supplement letters to the editor, grant applications, and organizing efforts by our community partners and other concerned citizens in the region. In follow-up interviews, our community partners reflected that the maps and analyses produced through LTP's iterative, participatory process exceeded expectations in terms of elevating local concerns, achieving local relevance, and encouraging discussions about the future. The former county planner explained part of the value of LTP this way: "it gives people something concrete to quote and to refer to, which is nice because generally a lot of our conversations are not based on fact" (Guffey 2006).

The material has also been influential beyond the county boundary. We have subsequently learned that the LTP project DVD, which included the documentary video and the presentation on landscape change, was among the campaign materials that helped to elect new, pro-planning county commissioners in neighbouring Jackson County (Shelton 2007), who went on to enact the most progressive development regulations in the region.

However, the landscape crisis depicted by the maps was not universally compelling to local stakeholders. In fact, the maps and visualizations produced became a focus of intense debate on the Macon County Planning Board. One board member in particular maligned LTP as "not factual at all"; supported primarily by radicals, not average citizens; and "funded by grants" (Lewis 2005). Despite these criticisms, the debate spurred by the project contributed to the planning board's first formal (albeit abortive) consideration of steep-slope regulations in the months following LTP's public meetings (Lewis 2006).

Discussion

By using a participatory research (PR) framework, LTP succeeded in grounding GIS and visualization in local experiences of a rapidly changing landscape. Through intensive interactions with community partners, the depth of insight on local perspectives gained through ethnographic research, and the amount of time spent in the community over the course of the process, PR kept the research team acutely aware of context – both physical and socio-political. The back-and-forth dialogue between the research team and local stakeholders involved progressively more participants as the project unfolded, which allowed us to refine images and explanations of trends for non-academic audiences while also exposing many participants for the first time to the capabilities of geospatial analysis. The contextualization engendered by this engaged process presented opportunities for both improved mapping and participant empowerment – which jointly helped build civic capacity to address the issues being mapped.

OPPORTUNITIES FOR IMPROVED MAPPING: INCREASED ACCESSIBILITY AND RELEVANCE

LTP's iterative approach and reliance on stakeholder feedback yielded maps and information about landscape trends in the community that proved both accessible and relevant to local audiences. Maps and visualizations were refined over the course of the project through a process of citizen critique: ongoing conversations with our community partners, input from focus groups, and feedback from participants in public meetings increased both the images' clarity to local audiences (i.e., their accessibility) and the degree to which their content addressed salient community concerns (i.e., their relevance). In other words, LTP drew on local perspectives to enhance, clarify, and "ground truth" GIS (Pickles 1995).

"Access to relevant information" is a key requirement for meaningful public participation (Cox 2006, 84); in LTP, the provision of accessible and relevant visual information contributed to a more productive civic dialogue during the formal meetings. The legible images about local landscape and development trends of interest encouraged participants to engage with the material and reduced barriers to sharing their own perspectives on the trends illustrated.

This process did not succeed in making all types of mapping and geospatial analysis accessible and relevant, however. For example, we failed to develop a good way to integrate remotely sensed data and land-use models into this project, because many participants found them difficult to understand. Perhaps a more intensive engagement process with a smaller group of stakeholders would be more likely to result in accessible versions of complex models.

However, LTP also illustrates that complex models are not necessary to increasing understanding of land-use trends and trajectories among the general public or local policy makers; in fact, commonly available data (e.g., parcel data), if thoughtfully situated and presented, can accomplish many of the educational and discursive goals commonly articulated by those embarking on complex land-use modelling initiatives. While we are not suggesting that there is no role for complex models of land-use change, we believe there is a clear need for a more comprehensive research program aimed not at improving

technical capabilities in landscape analysis but at guiding the development and deployment of geospatial information in community dialogues and local policy-making contexts.

OPPORTUNITIES FOR PARTICIPANT EMPOWERMENT

Highlighting and Legitimating Shared Concerns of Local Residents

The expert, technical apparatus of quantitative geospatial analysis and mapping, when grounded in ethnographic research, helped to empower participants by legitimating their concerns about the changing landscape within Macon County's public discourse. By making visible landscape degradations that were locally significant, LTP foregrounded views that had previously been effectively delegitimized by pro-growth leadership and marginalized in formal decision-making processes. This use of mapping fulfils the critical GIS mandate to support "new configurations of space, subjectivity and power" (kanarinka 2006, qtd. in Kwan 2007, 28) that can be used for "countering the dominant practices" (28) – in this case, amplifying the voices of average residents who perceive negative impacts from unplanned growth.

The viewshed analysis and subsequent visualizations exemplify the legitimization function of the LTP mapping process. Engagement with these images encouraged Macon County residents to recognize an issue of broad (though not universally) shared concern: steep-slope development. Prior to LTP, the conventional wisdom in Macon County was that property-rights ideology trumped concerns about the negative impacts of development on steep slopes or mountainsides. Through mapping and the deliberative public process through which the imagery was shared, local stakeholders recognized for the first time that many of them shared a belief in respecting the mountains by not building on them. Disseminating the maps in some ways served as an *image event* (DeLuca 1999), simultaneously validating individually held concerns, challenging assumptions about public sentiment, and suggesting the possibility of collective response. If "feminist visualization is grounded in the view from a body … versus the view from above, from nowhere, from simplicity" (Kwan 2002, 649), then it is reasonable to interpret the viewshed map as the collective view from many bodies that constituted a previously diffuse constituency: those troubled by prevalent development patterns. This "collective body" was a unit larger than the individual that, LTP proposed, could have valid authority over land-use decisions.

Advancing Awareness of Landscape-Scale Processes

Making visible issues of local concern served not only to legitimate marginalized community perspectives, but to advance understanding of the issues themselves (Wilson and others 2004). By scaling "concern from the personal/local level up to larger contexts" (Kwan 2007, 30), LTP maps, including the viewshed images and the property-ownership map, enabled many project participants to perceive for the first time the landscape-scale processes underlying their individual observations – an experience that we termed "thinking like a landscape." Though tied to the recognition of marginalized voices described above, engendering landscape-scale thinking was not a matter of legitimating underrepresented stakeholders' views but of legitimating consideration of the broader landscape and policy context within which those stakeholders were embedded.

Attempting to make visible landscape-scale processes that were linked to residents' experiences of place exposed a key tension in the project, one that resulted from combining critical/participant-driven and analytical/expert-driven approaches. Mapping, as it evolved in LTP, required negotiation between (a) documenting and mapping concerns as they were expressed in interviews and (b) introducing external data that would challenge stakeholders to take a more long-term, large-scale view of local issues. In other words, we wanted not only to make maps that represented and validated existing community discourses but also to challenge the boundaries of those discourses by using quantitative data sets to expand the spatiotemporal scale of issue framings.

SUPPORTING THE POSSIBILITY OF COLLECTIVE RESPONSE

By generating maps and visualizations that were *relevant* to local experience and *accessible* to local stakeholders, on the one hand, and by effectively linking *individual perspectives* on change to the *landscape-scale processes* affecting Macon County, on the other, LTP fostered new opportunities for county residents to consider collective responses, such as land-use planning, to growth challenges. This happened in several ways. First, the project enabled community members to draw on new kinds of data (such as the viewshed map) or new elucidations of existing data (such as the parcel-ownership maps). Second, the subject matter and scale of the maps supported the consideration of collective response. While some maps focused on individual properties or subdivisions, most focused on the landscape/county scale (e.g., trends in property ownership across the county, changes in average elevation of new homes, changes in density of development near US Forest Service lands, and the community viewshed). By drawing attention to the cumulative effect of uncoordinated land-use decision making already visible in the present, and projecting some of these trends into the future, these maps downplayed the primacy of any individual landowner, thereby fostering a conversation that was more about "our landscape" and "our community" than about "my property" or "your property." Third, by deploying these maps and visualizations within a carefully orchestrated deliberative meeting format, the process itself sup-

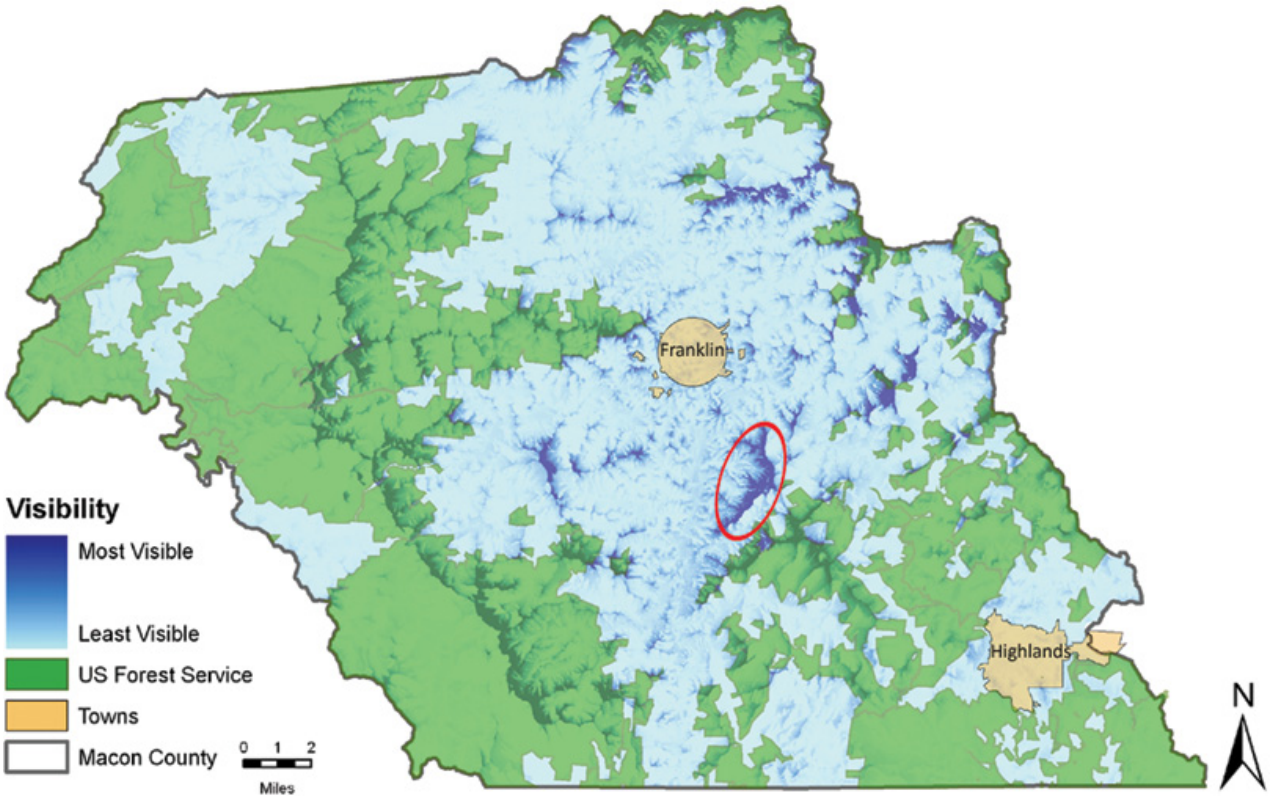

Figure 2. Cumulative viewshed map, highlighting location of the most visible privately owned hillside in Macon County, NC.

Figure 3. ArcScene rendering of property lines on Macon County's most visible privately owned hillside, 2005. The blue dots highlight the location of existing houses.

Figure 4. Photo-based build-out scenario of currently undeveloped parcels on a portion of the same hillside shown in Figure 3.

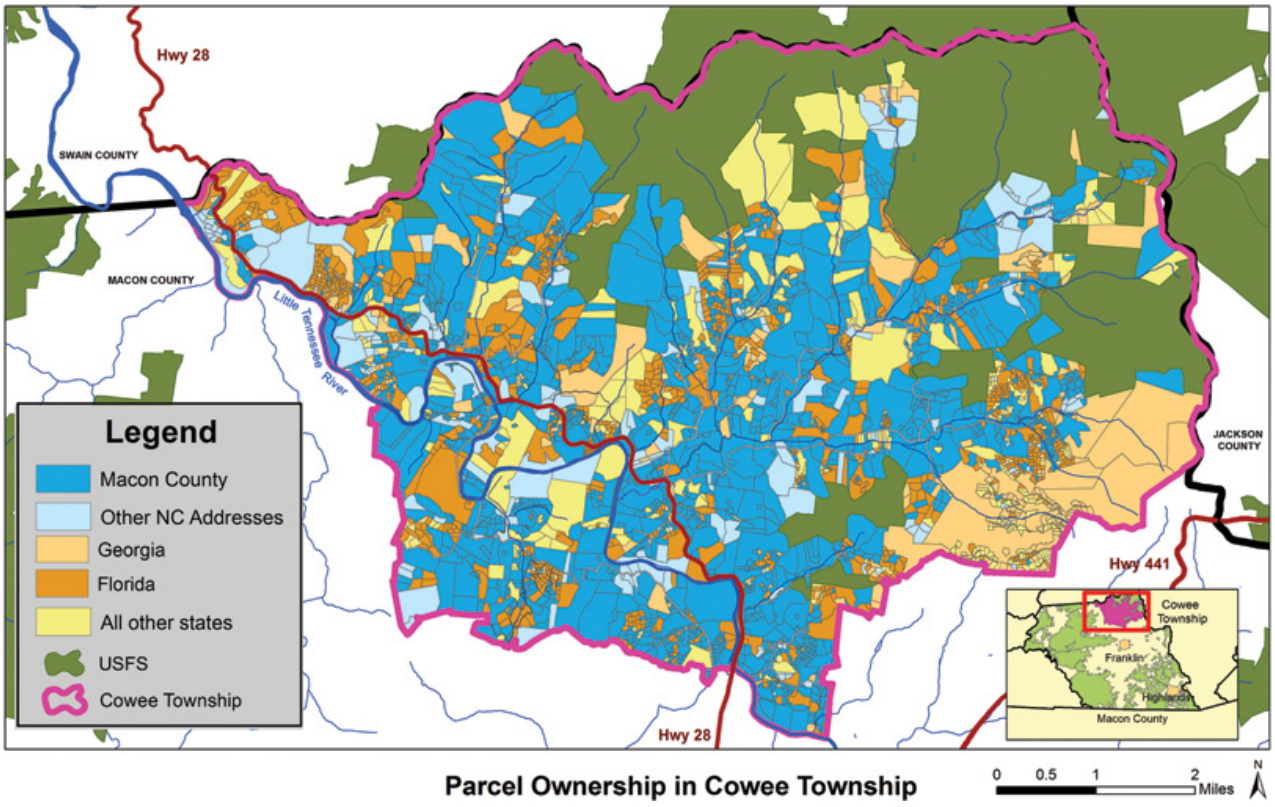

Figure 6. Distribution of parcel ownership in Cowee Township, 2008.

ported a more productive public conversation about land use and planning than most participants had previously encountered. The meeting design was critically important in creating a space where residents could consider the long-term, cumulative impacts of many isolated land-use decisions in light of their own values and the values articulated by their fellow residents. Fourth, by freely sharing our maps and statistics with interested parties, we encouraged their use of these materials following the conclusion of our formal process.

In these ways, the maps and visualizations, embedded within a participatory process, helped to build local capacity to address land-use challenges and generated momentum for crafting community-scale responses to amenity migration. Following the meetings, the maps/visualizations became "gradually embedded in the understandings of the actors in the community, through processes in which participants … collectively create meanings," thus influencing the local discourse about growth management and informing ongoing engagement efforts (Innes 1998, 53). While LTP did not directly precipitate policy change that would allay local concerns about amenity-driven growth and steep-slope development, it did influence the local discourse about planning. For example, the process has been credited with opening the door to an unprecedented regional planning initiative that took place in 2007–2008,[11] which the authors helped to plan and implement.

Conclusion

For many residents in rapidly growing rural communities like Macon County, NC, poorly managed development is an urgent and deeply felt issue; more inclusive and informed discussions about local land-use planning are urgently needed. Little Tennessee Perspectives identified important contributions that GIS analysis and mapping can make to such discussions – providing access to relevant information, legitimating marginalized perspectives, and encouraging consideration of landscape-scale processes. By grounding mapping in local experiences of place and demonstrating that mapping can help build communities' collective capacity, LTP addressed critical GIS mandates.

The potential benefits of geospatial analysis and visualization to community decision making and capacity building are often casually mentioned in, but are seldom the focus of, academic studies. As a result, more research is needed on how best to develop and use these tools in ways that can actually help communities better understand the implications of different decisions and act effectively on behalf of the landscapes they call home. We believe that better situated mapping can materially support more just, democratic, and ecologically sustainable outcomes and that developing ways of realizing this potential is a worthy field of inquiry in its own right.

Acknowledgements

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Author Information

Carla Norwood and Gabriel Cumming are devoted to improving resource management, land-use planning, and civic engagement in rural areas. As graduate students at UNC Chapel Hill, they developed the Community Voice Method, part of which is described in this article. Carla is currently director of Working Landscapes, PO Box 902, Warrenton, NC 27589 USA (a non-profit devoted to rural revitalization), and principal of Community Voice Consulting; Gabriel directs the Warren County Economic Development Commission, 501 US 158 Bus. East Warrenton, NC 27589 USA. Although no longer based in academia, they remain committed to using research and analysis to help communities make plans for the future that better reflect local perspectives and honour landscape function. They live in Manson, NC, with their three-year-old daughter, Juniper.

Notes

1. One of the authors (Norwood) was a founding member of Macon Tomorrow, having moved to the area in 2002 to direct the Little Tennessee Watershed Association. She left that position for graduate school in 2003 and helped to initiate the Little Tennessee Perspectives (LTP) project in 2004.
2. Viswanathan and others (2004, 24) have identified four modes of participation: *contractual* (whereby researchers contract for services from community members), *consultative* (whereby community members are asked for guidance before the research project), *collaborative* (whereby researchers and community members "work together on a study that is designed, initiated and managed by researchers"), and *collegiate* or collegial

(whereby researchers and community members "work together as colleagues, each with different skills to offer for mutual learning, to develop a system for independent research among local people"). In this model, LTP fits best within the collaborative mode of research, but has some characteristics of the collegial mode, especially given that the impetus for the project came from Macon Tomorrow, a grassroots group. Collaboration has often been operationalized through the development of a partner committee such as the one described here.

3. Margaret Browne, a fellow graduate student at UNC, helped to organize and carry out the focus groups.
4. This response rate compares favourably with those of other surveys conducted in Macon County, including an academic survey reported in Cho and others (2005) that achieved a 34% response rate and a non-profit survey in 2002 whose response rate was 32%.
5. Wear and Bolstad (1998) developed a land-use change model to forecast development in the Upper Little Tennessee watershed in 2030, which sparked our interest in public perceptions and policy outcomes of land-use models and visualizations.
6. The ArcInfo *vshed* function requires a line input layer (class 1, 2, and 3 roads from the North Carolina Department of Transportation) and a grid-based DEM. Many thanks to Bev Wilson, who helped us run this analysis.
7. The resulting cumulative viewshed grid was classified into four categories using a standard deviation classification. The designation *most visible* refers to those cells more than 3 standard deviations more visible than the mean visibility.
8. This build-out image was created in Adobe Photoshop, by Ursula Lang, using photos of the subdivision and photos of other mountainside developments in the region taken by the authors.
9. Macon County maintains a Web site from which GIS data, including parcel data, can be downloaded for free; this has been a valuable resource for our research. Several steps were taken to clean up the property database before making calculations about property ownership. The first step involved removing duplicate entries (e.g., where a single property had more than one entry because it was bisected by a road) from the database. Significant cleaning was also required to sort out states and ZIP codes, mainly because of inaccuracies in data entry (e.g., city, state, and ZIP entered in the wrong columns).
10. Most of the participants were couples, and we observed that many couples completed only one evaluation form.
11. The Mountain Landscapes Initiative was a seven-county regional planning effort sponsored by the Southwestern Commission and the Community Foundation of Western North Carolina. This effort enjoyed unprecedented public and political support and used the citizen engagement approach modelled by LTP.

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