



Research Paper

Visualizations of mosquito risk: A political ecology approach to understanding the territorialization of hazard control



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HIGHLIGHTS

- Use of visualizations unveiled participants' beliefs about mosquito ecology.
- Visualizations of risk elicited different hazard responsibility than other methods.
- Health managers and residents responded most strongly to different map depictions.
- A political ecology approach coupled with maps uncovered notions of territory.
- Risk maps can act upon participants to produce landscapes of fear.

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ABSTRACT

Sophisticated geospatial modeling of environmental problems and hazards is far advanced in geography, decision science, and related fields. The political ecological application of these tools, especially in visualizing, debating, and contesting risk, is underdeveloped, however. By using visualizations of risk as an analytical tool to explore the views of citizens and county health officials, geospatial models can help to explore the schisms, connections, and associations among complex landscapes, diverse publics, and logics of governance. In this paper, we explore the case of West Nile virus in the Southwest United States, a site where county health departments, vector control districts, and urban residents practice varying methods of mosquito management. We created geospatial visualizations of mosquito microhabitat using a dynamic simulation model and remotely sensed imagery. These data, when differentially aggregated, produced divergent visualizations of mosquito risk spaces across the city of Tucson. Presenting maps to neighborhood residents and local health officials, we found they invited different understandings of spatialized areas of responsibility for mosquito management. Neighborhood focus groups expressed territorial notions of risk and responsibility that diverged widely from those of health officials. Visualizations were shown to both reflect and produce different mosquito narratives, showing how mapped models can help elicit political–ecological insight into the territorialization of mosquito control.

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1. Introduction

Visualizations, such as maps and model outputs, have been used for centuries to condense and convey geographical information, with recent developments focusing on the interactive capabilities of computer-based geovisualization. Lately, epistemological boundaries have been blurred through the incorporation of geographic visualizations as analytic tools in social science research. Using visualizations as representations of quantitative

data and qualitatively evaluating their impact on their creators and observers has spurred numerous studies within geography (Knigge & Cope, 2006; Nightingale, 2003; Robbins, 2003; Rutchick, Smyth, & Konrath, 2009).

With the expansion in technical capacity, however, came increasing scrutiny of the political implications and effects of geographic visualization. Early use of new visualization technologies such as geographic information (GIS) was exposed to common critiques of maps focused on the uneven power relations embedded within the production of scientific knowledges at the expense of “non-expert” ways of knowing and visualizing space that reproduced hegemonic power structures through mapping (Harley, 1989; Miller, 1995; Pickles, 1995; Wood, 1992). Conversely, feminist geographers, among others, have noted the utility of GIS as a method to break open new realms of interpretation instead of masking them, allowing more nuanced exploration of research questions (Kwan, 2002; Pavlovskaya, 2006). The net effect of these observations is the recognition of both the power-laden character of mapping and its concomitant political analytical possibilities.

Scholars within the field of political ecology have recognized the power of these visualizations, but have less frequently used visualizations as a tool for political ecological analyses themselves. The subfield explores the spatial and temporal connections among material nature, social systems, and political economy. This approach empirically investigates the social construction of environmental problems and examines the power structures behind these constructions (Blaikie, 1999; Robbins, 2012; Watts & Peet, 2004; Watts, 2000).

In this paper we explore the use of hazard maps and their potential to delve into new areas of research that would otherwise not be possible by combining a dynamic mosquito life cycle model with remotely sensed imagery. This coupling produced two map-based visualizations of mosquito abundance risk in Tucson, Arizona that were shared with participants via focus groups. The results illustrate new interpretations of hazards and risk in terms of their politics of responsibility, illuminating connections, schisms, and associations among residents and county health officials, and revealing understandings, beliefs, and actions that were previously undiscovered. A political ecology approach combined with visualization methods highlights the discourses that permeate public health concerns and interrogates the production of these discourses. At the same time, this research forces the recognition that the production of hazard maps themselves exerts political influence and reproduces the often uneven power dynamics between map creators/presenters and research participants (in this case, Tucson residents and county health officials). It further illuminates the inevitable role of such mapping exercises in creating or re-instantiating territorial notions of fear or threat.

Focusing on perceptions of mosquito spaces in Tucson amongst the public and health agency officials, this research explores the use of visualizations as an analytic method in political ecology. The following section provides a review of current approaches using visualizations in political ecology and concludes with our research questions addressing gaps in this literature. Following that, we present our case study of mosquito management in Tucson, Arizona and our methodological approach incorporating surveys, visualizations, and focus groups. After this, the results are presented, addressing how visualizations can aid in discerning notions of territoriality and responsibility in ways other methods cannot achieve. Our discussion addresses the power of visualizations, and we conclude with the importance of this line of work for hazards research in political ecology.

2. Visualization and political ecology

Research utilizing visualizations as a tool to link both qualitative and quantitative approaches in geography has spanned across sub-fields ranging from political geography to cultural ecology and feminist geography to GIScience. For example, Rutchick et al. (2009) demonstrate how quantitative electoral data translated into red and blue binary maps of the U.S. states increases voter perception of a polarized nation and propagates the opinion among residents that their votes do not matter in determining election results. In a different vein, Knigge and Cope (2006) developed the methodological approach of grounded visualization, whereby the social theory grounded in every day practices and visualizations are combined to uncover the human experience of place in ways that could not be seen otherwise. They use a combination of participant observation with neighborhood maps to explore how racial groups form attachments to place and shape these spaces, arguing that this approach is iterative, exploratory, and allows the existence of multiple interpretations.

Visualizations have also been an important tool within physical geography, particularly within the broader hazards tradition (for a brief overview, see Montz & Tobin, 2011). Time lapses of aerial images have been important for delineating hazardous sites (Campbell, 2007). Remote sensing technologies allowed for the development of more sophisticated algorithms inclusive of satellite data to study hazards such as drought (Kogan, 1995). Further advancements in GIScience facilitated the application of these technologies to numerous natural and physical hazards and emergency situations (Cova, 1999). Despite these advancements, “analyses directed to testing the effectiveness of visualization in communicating risks are not common” in hazards and applied geography work (Montz & Tobin, 2011, p. 3), demonstrating an ongoing need to investigate the social work of, and response to, visualizations. Within hazards research a shift toward the social nature of hazards, focused on the social response to risk and the production of marginalization, marked a disjunction from a typically earth-science dominated framework (Burton, Kates, & White, 1968; O’Keefe, Westgate, & Wisner, 1976). Growing out of this tradition, a political ecological approach to hazards considers not only the hazard in terms of its biophysical content, but also its political economic factors (Liverman, 1990). It is this focus on institutional and social components that separates political ecological hazards work from the hazards research more dominant in physical geography.

However, within the field of political ecology, the use of geospatial visualizations as an analytic tool for exploring environmental hazards remains underexplored, particularly pertaining to debates and contestations of risk. GIScience techniques have been promoted as an effective research methodology within the realm of human ecology (Turner & Taylor, 2003), but room remains for exploring the political and economic implications of visualizations. More common uses of visualizations include interrogating an issue of importance to the field of political ecology, rather than investigating the impact of the visualizations themselves. For example, Heynen’s (2006) use of remote sensing technology to illustrate the relationship between tree cover and racial group access to trees illustrates underlying issues of equity, though the use of these maps is not integrated into the solicitation of results.

This is not to say, however, that political ecologists have ignored developments in GIScience and visualization. Some political ecologists have engaged visualizations, such as maps, to counteract structures of power, a central component of political ecological praxis. Political ecologist Nancy Peluso (1995) used the term “counter-mapping” to refer to the use of technical mapping to counteract hegemonic power structures, enabling counter-mappers to make their own claims to resources. Also using maps to disrupt

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