Agriculture and Human Values (2019) 36:241–256
https://doi.org/10.1007/s10460-019-09914-5

Desert wonderings: reimagining food access mapping

Kathryn Teigen De Master[1] · **Jess Daniels**[2]

Accepted: 7 January 2019 / Published online: 25 January 2019

Abstract
For over 20 years, the concept of "food deserts" has served as an evocative metaphor, signifying spatialized patterns of injustice associated with low access to nutritious foods through retail and social exclusion. Yet in spite of its pithy appeal, scholars and activists increasingly critique the food desert concept as stigmatizing, inaccurate, and insufficient to characterize entrenched structural inequities. These well-founded critiques demonstrate a convincing need to reframe approaches to spatialized food injustice. We argue that food desert maps, which aim to visually illustrate food inequality, can reproduce problematic assumptions, stigmas, and inaccuracies that form the crux of scholarly critiques. For example, food desert maps typically overlook community assets and also utilize decontextualized and overdetermined indicators, such as proximity to supermarkets and transportation access. Although we acknowledge the contributions of food desert maps, in this paper we propose a reimagining of food access mapping. To illustrate our argument, we present a course-based food justice mapping study in Providence, Rhode Island. Our project draws inspiration from studies that interrogate the deficit-oriented framing of food deserts, as well as several alternative mapping practices: critical cartography and counter-mapping, community asset mapping, participatory geographic information systems, and radical cartography. We suggest these alternative mapping approaches have potential to move practitioners and viewers beyond the desolate "desert" vantage point and toward a more textured understanding of community food access that inspires engaged exploration.

Keywords Food deserts · Food access · Critical cartography and counter-mapping · Asset mapping · Participatory mapping · Radical cartography

Introduction

In the 1990s, a Scottish public housing resident described her neighborhood to an ethnographer as a "food desert" (Cummins and Macintyre 2002, p. 436). This novel, evocative metaphor quickly seized the imaginations of scholars, practitioners, and the public, pithily denoting the spatialized patterns of injustice associated with low access to nutritious foods through retail and social exclusion (Beaumont et al. 1995; Morland et al. 2002; Soss et al. 2011; Ver Ploeg 2009; Whelan et al. 2002; Wrigley 2002; Wrigley et al. 2003). Subsequently, a host of public health and economic development initiatives emerged to combat food deserts. However, as Wrigley et al. (2003, p. 151) noted, "It soon became clear…that ["food desert"] was a metaphor which urgently needed 'unpacking' and subjecting to critical evidence-based assessment."

"Unpacking" the food desert concept has indeed spawned a host of "critical evidence-based assessment" studies, as well as a range of sharp critiques. For example, New York City food activist Karen Washington asks:

> Who in my actual neighborhood has deemed that we live in a food desert? Number one, people will tell you that they do have food. Number two; people in the hood have never used that term. It's an outsider term. "Desert" also makes us think of an empty, absolutely desolate place. But when we're talking about these places, there is so much life and vibrancy and potential. Using that word runs the risk of preventing us from seeing all of those things (Washington, in Brones 2018).

✉ Kathryn Teigen De Master
kathryn.demaster@berkeley.edu

[1] Department of Environmental Science, Policy & Management, University of California-Berkeley, 130 Mulford Hall #3114, Berkeley, CA 94720, USA

[2] Fibershed, P.O. Box 221, San Geronimo, CA 94963, USA

Scholars similarly challenge the food desert concept for implying, often inaccurately, that food desert communities are utterly devoid of healthy food resources (e.g., Cummins and Macintyre 2002; Morton et al. 2005; Raja et al. 2008; Short et al. 2007; Sparks et al. 2011; Widener et al. 2011; Taylor and Ard 2015). Others object to stigmatizing language in media coverage of food deserts that draws attention to "oasis" initiatives within "deprivation" zones and emphasizes efforts to "eradicate" these areas, while eliding community resources (e.g. see Yaccino 2011; Peters 2013; Tepper 2011; Thomas 2011; Walsh 2011). Some of the more forceful critiques emphasize how food desert framing invokes racial, ethnic, and colonialist codes (Guthman 2008), "normalizes middle-class 'foodscapes'" (Shannon 2014, p. 2), and fosters visions of "communities… perceived through a 'deficit' lens, [generating] top-down educational, technocratic, aid-based solutions that rely on a high level of intervention on the part of outside actors" (Figueroa 2015, p. 501). As activist LaDonna Redmond has explained, **"**Food desert identifies for corporate America how to sell cheap, off brand food to our community" (Redmond, in Fields 2013). Moreover, with notable exceptions (e.g. Wrigley et al. 2003), numerous studies note a failure to establish a convincing link between healthy food access and healthy eating (e.g. Alkon et al. 2013; Cummins and Macintyre 2002; Coveney and O'Dwyer 2008; Elbel et al. 2015; see also; Brinkley et al. 2017; Guthman 2011; Hackett et al. 2008; Handbury et al. 2015; McEntee 2009; Todd and Ver Ploeg 2015), suggesting that "if you build it, they will come" approaches to food access are best left to the movies (e.g. Guminski 2015, see also; Alkon et al. 2013).

These critiques present scholars and practitioners with methodological and conceptual challenges. How might we identify, examine, and address entrenched spatial patterns of food injustice, while also heeding well-founded opposition to food desert framing? These challenges are powerfully embodied in food desert maps, which typically quantify food access by combining spatial data on supermarkets with a range of social and economic metrics. On the one hand, food desert maps critically illuminate and visualize spatial inequities by showing how processes of devaluation, capital retreat, redlining, and deindustrialization articulate with food injustice (e.g. McClintock 2011). As such, they have represented a progressive step forward in highlighting the structural contributions to food access dilemmas. On the other hand, food desert maps oversimplify complex food access problems by reducing them to a few decontextualized and overdetermined indicators, such as distance to grocery stores or transportation access. Moreover, with notable exceptions (Short et al. 2007; Raja et al. 2008; Taylor and Ard 2015), the majority of food desert studies and associated maps elide community assets, which can reproduce some assumptions and stigmas that food desert residents and scholars critique.

In this paper, we ask: How might food desert mapping be reimagined to sustain the incisive critiques of residents, scholars, and practitioners, while also illuminating patterns of spatialized food injustice, such as "food apartheid" (e.g. Saletan 2008; Sbicca 2012; Washington 2018)? As we consider this question, we present a pedagogical case study of a food justice mapping project in Providence, Rhode Island, heuristically inspired by several alternative mapping practices: critical cartography and counter-mapping, community asset mapping, participatory GIS, and radical cartography. We argue that these alternative mapping approaches can help re-envision the food desert "problem" by informing more textured, nuanced understandings of community food access, disrupting stigmatizing gazes, and inviting community engagement with creative visualizations. Our case study builds upon the contributions of scholars who have critiqued the deficit orientation of much food desert framing (e.g. Short et al. 2007; Raja et al. 2008; Taylor and Ard 2015), as well as those who have suggested that participatory GIS might move food desert mapping past some of its limitations (e.g. Shannon 2014). As we describe the process of creating our "food topographies" map of Providence, Rhode Island, we aim to contribute to the reimagining of food access mapping.

Literature review: mapping out food desert mapping

Since the emergence of the food desert concept over 20 years ago, food desert studies and associated maps have proliferated. Scholars and practitioners have now conducted food desert studies for many major cities and rural areas in North America and the United Kingdom, as well as a growing number of geographic locales, ranging from Slovakia (Bilková and Križan 2015) to Botswana (Battersby and Crush 2014) to Australia (Pollard et al. 2014), to name a few. The explosion of these food desert studies has occurred in concert with the increased ubiquity of powerful mapping technologies and visualization tools, including geographic information systems (GIS) as well as the "visual turn" of the 1990s within geographic and sociological scholarship (e.g. see Thornes 2004; Rose 2003; Pickles 2003; Harper 1998). An emphasis on visualization has also spread to agrifood studies more broadly (e.g. Howard 2009; Gillespie 2003), evidenced by the surge of interest over the past 20 years in various forms of food systems and "foodshed" mapping (e.g. see Kloppenburg et al. 1996; Horst and Gaoloch 2015).

GIS tools in particular have enabled the widespread quantification and visualization of food deserts by combining layers of spatial data on supermarket location and density with food access metrics, such as transportation

availability and distance to markets. Metrics have become increasingly detailed and refined over time, as mappers have incorporated additional indicators into food desert maps, such as income, race, ethnicity, the presence/absence of certain valorized foods, and various measures of commute times and distances. However, the fundamental assumptions underpinning food desert maps remain largely unchallenged and unchanged. Thus, while scholars and practitioners have become increasingly reflexive about the food desert concept generally, less attention has been given to interrogating the framing and visualizations of the maps themselves.

In the US, the most expansive and well-recognized food desert map is the USDA's "Food Access Research Atlas." Initially released in 2011 as the "Food Desert Locator," the USDA map offered a groundbreaking view of the food environment and represented the culmination of a 2009 Report to Congress on "Measuring and Understanding Food Deserts and Their Consequences" and was part of First Lady Michelle Obama's "*Let's Move!*" initiative (Ver Ploeg and Breneman. 2011). Today's Food Access Research Atlas employs GIS tools to identify and visualize food deserts through a dynamic, interactive online map. The recognizable image of the continental United States serves as a neutral-colored canvas with clusters of opaque geometric shapes featured prominently on this canvas. The Food Access Research Atlas highlights census tracts as low income and low access layers, dubbed the "original Food Desert measure" (Ver Ploeg et al. 2015). As the user searches with the "Find Address" tool, each food desert becomes a clickable feature and each click offers a window to demographic and food access statistics. A host of studies employ the USDA Food Access Research Atlas as a foundational layer for regional and local food desert maps.

While the USDA map has garnered the most widespread media attention (e.g. see Tepper 2011; Walsh 2011; The Economist 2011), several prominent food desert studies and associated maps published in the last decade employ similar food access measures and utilize GIS tools. For example, the Baltimore City Food Environment Map, created through a partnership of academic researchers from Johns Hopkins University's Center for a Livable Future and the city's Office of Sustainability, emulates the USDA map by employing similar metrics of food access. The Baltimore City Food Environment map also refines the method for measuring food deserts by including not only distance to a supermarket or supermarket alternative (greater than ¼ mile), median income (at or below 185% of the Federal Poverty Level), and transportation access (more than 30% of households have no vehicle), but also a "Healthy Food Availability Index" nutrition assessment, gleaned from data developed following modified procedures of Nutrition Environment Measures Survey in stores (Buczynski et al. 2015).

Other food desert studies have incorporated additional social measures, such as racial segregation, into maps. For example, a foundational study by Morland et al. (2002) uses local department of health and agriculture data across four US states—Maryland, Mississippi, North Carolina, and Minnesota—to map all available food outlets, combining these sites with census tract-level information on wealth and racial segregation. This food desert map presents evidence of racialized access to all food outlets, including supermarkets, gas stations, and convenience stores with wealthier, white neighborhoods experiencing higher access, while poorer, black neighborhoods experience a dearth of these services, coupled with disproportionately abundant access to alcoholic beverages (Morland et al. 2002).

In addition to including new social measures to food desert maps, some mapping studies have refined and complicated the question of quantifying distance to supermarkets. For example, Goldsberry et al. (2010) incorporate both pedestrian and vehicle travel times, as well as the specific dimensions of fresh produce availability, into their interactive food desert atlas of Lansing, Michigan. Widener et al. (2011) have similarly added a spatiotemporal dimension to a food desert map of Buffalo, New York, by measuring commuting patterns and times to food outlets, rather than mapping mere Euclidean distance. In a similar, novel approach, Chen and Clark (2015) add a provocative three-dimensional geovisualization to their food desert study, incorporating a time dimension along with the spatial elements into their map. In another prominent analysis, Leete et al. (2012) draw upon food desert studies conducted in Edmonton, Alberta to further refine food access distance measures. They introduce the concept of a "food hinterland" to a Portland, Oregon map and include suburban areas with low food access and economically vulnerable populations whose concentration does not meet standardized definitions of food deserts.

Similar to the "hinterland" map, "food swamp" maps were introduced in an effort to recast the food desert "problem" by mapping "areas in which large relative amounts of energy-dense snack foods, inundate healthy food options" (e.g. Rose et al. 2009, p. 2). This mapping approach has garnered significant attention in the public health arena, spawning a plethora of maps and mapping comparisons between food deserts and food swamps and highlighting "unsupportive" food environments (e.g. Fielding and Simon 2011; Minaker et al. 2016). An additional variation on the food desert map are maps of "food mirages" that illuminate how gentrification compounds food access problems, when "grocery stores are plentiful but prices are beyond the means of low-income households, making them functionally equivalent to food deserts" (Breyer and Voss-Andreae 2013, p. 131).

While these food desert mapping studies have helped shape the field, an abundance of additional maps abound

that employ similar metrics and GIS tools. Moreover, in 2010, the leading GIS software mapping company in the US, ESRI, began mapping food deserts (e.g. see Herries 2010), utilizing its popular ArcGIS software program. The ESRI map employs the measures of low income and low access to supermarkets as its key measures of food access. ESRI ArcGIS mapping software is so ubiquitous today that it has been described in a comprehensive overview of GIS programs as "…the powerhouse in GIS. It's so influential that the term ArcGIS is sometimes (mistakenly) used interchangeably with GIS."[1]

Some key studies have augmented elements of the standard quantitative GIS food desert maps by adding qualitative data, an approach that some scholars have suggested can address some of the overly positivistic limitations of GIS generally, as well as with food desert mapping specifically (e.g. Elwood 2006; Pavlovskaya 2009, 2018; Shannon 2014). For example, qualitative assessments were critical in measuring the potential for a food desert in Whelan et al.'s (2002) foundational study in the U.K., in which households were found to value physical access to grocery stores differently, depending on their composition, which complicated the question of uniform spatial measures. Alkon et al. (2013) also deftly trace actual food practices of low-income residents of Detroit and Oakland through in-depth interviews and focus groups; though their qualitative study did not involve creating a visual map, their work has shaped the conceptual mapping landscape, underscoring the importance of tracing actual foodways of residents of areas labelled food deserts. LeClair and Aksan (2014) also add qualitative assessments to their food desert map of Bridgeport, Connecticut, to determine "what products are actually available to residents not served by a major grocery store" (LeClair and Aksan 2014, p. 538). And similar to Alkon et al. (2013), MacNell et al. (2017) further advance the conversation around qualitative methods and food desert mapping by employing in-depth interviews with low-income residents of a Raleigh, North Carolina neighborhood; their study illuminated how and where and residents accessed food and found that food cost, as well as transportation availability, were the most relevant metrics of food access.

The host of food desert maps created in the past 20 years have clearly made critical contributions toward identifying, measuring, and highlighting spatial inequities of food access. As such, nearly all food desert maps consistently employ a deficit orientation to illuminate various forms of injustice: deprivation, exclusion, and socioeconomic erasure. Most of these maps also share similar metrics and employ GIS-generated surveys and mapping tools (such as ArcGIS). Since these tools map food deserts using similar parameters, this can and has enabled valuable food access study comparisons. However, such standardization can also create a normalizing frame for measuring food access in which the assumptions and indicators *underlying the maps* become codified and are rarely questioned.

Such standardized GIS food desert maps can then be deployed as what George and Louise Spindler, as they introduce the work of classic visual anthropologist Collier, have described as a "highly selective confirmation that certain things are so, or as a very selective sample of 'reality'" (Collier 1967, p. 10). This selective vision can obscure the ways that food desert maps not only reflect particular spatial contexts and conditions, but actively socially construct and intervene in them through powerful, positivist, visual representations, often reinforcing the visions of people outside food desert communities. Mainstream GIS has drawn vigorous critique in the geographic literature for failing to interrogate the power dynamics embedded in these kinds of technocratic visual interventions. As geographer Mei-Po Kwan explains, GIS in particular has been critiqued for its "…inadequate representation of space and subjectivity, its positivist epistemology, its instrumental rationality, its technique-driven and data-led methods, and its role as surveillance" (Kwan 2002, p. 645; see also; Elwood 2006; Pavlovskaya 2009; Sheppard 2005). As Harris and Hazen similarly ask, referencing an extensive body of critical cartographic literature, "What relations of power and partiality does the map itself produce?" (Harris and Hazen 2006, p. 101).

In spite of these trenchant critiques of mainstream GIS, most food desert mapping lacks deeper consideration of the power relations behind predominant maps or their performative nature. Although critical geographers of agrifood systems have indeed engaged questions of power and partiality in food desert studies (e.g. Guthman 2008; Shannon 2014, 16; Short et al. 2007; Galt 2011), outside the geographic literature there has been less critical examination of the power hierarchies these particular visualizations reproduce. Moreover, very little attention has been given to the power and partialities embedded in food desert maps themselves or—critically—to forwarding alternative visualizations of food access maps that may offer visual antidotes. Such uninterrogated, limited, and consistently reproduced visualizations can easily reinforce the kind of framing that, as Jerry Shannon contends, invokes an "expanded, spatialized form of 'neoliberal paternalism' [that] normalize[s] middle-class 'foodscapes' as a model for low-income areas" (Shannon 2014, p. 2).

Of course, the "paternalism" embedded in maps has a long legacy, given that historically, mapping has served as the vanguard of various forms of colonization. From the maps of early explorers credited with "discovering" already-populated continents, to the enclosure maps of England and

[1] Accessed at (https://gisgeography.com/mapping-out-gis-software-landscape/).

Wales, to modern gene mappers and gentrifiers, mapping frequently heralds conquest. However, we argue that there are a range of alternative mapping approaches that have potential to disrupt limiting, underlying assumptions within food desert maps, inspire new visualizations, and actively promote social change. We now proceed with a brief review of these approaches for mapping food access that heuristically inspired our Providence mapping project: critical cartography and counter- mapping, community-based asset mapping, participatory GIS, and radical cartography.

Critical cartography and counter-mapping

Critical cartography's emergence can be traced to the World War II era, when J.K. Wright argued that "maps are indispensable instruments of war" (Wright 1942, p. 8, in Stallmann 2012, p. 7). Timothy Stallman notes how, building upon that intellectual legacy and developments within critical theory, "J.B. Harley argued for a methodology of… reading for silences on the map … [arguing that] 'a hidden agenda has to be teased out from between the lines of the map' and that analysis of maps should proceed through a search for silences" (Harley 2001, p. 45, in Stallmann 2012, p. 9). In their "Introduction to Critical Cartography," geographers Jeremy Crampton and John Krygier characterize critical cartography "as a one-two punch of new mapping practices and theoretical critique" (Crampton and Krygier 2005, p. 11). Ryan Galt (2011, p. 136) similarly explains, "The 'critical' in critical cartography/GIS means many things (Sheppard 2005), yet generally refers to work exposing ideologies embedded in maps and their social effects, and proactive efforts to create alternative maps (Elwood, 2010) … [and] enables [the] interrogation of the reliability of self-evident data."

As a specific form of critical cartographic practice, "counter-mapping" emerged within the political ecology literature in the context of the economic maneuvering and land and resource grabs associated with the development model. Political ecologist Nancy Peluso first coined this term in 1995 to describe efforts by non-governmental organizations (NGOs) representing local, indigenous forest communities in Kalimantan, Indonesia to counter state-based (and World Bank financed) claims to local forests. These NGOs, employing the same mapping strategies as the Indonesian state, began "counter-mapping" their forests to make their land rights claims. As Peluso (1995, p. 384) describes, this effort was "far-reaching: the use of maps and a highly 'territorialized' strategy redefines and reinvents customary claims to standing forest resources and harvestable products as claims to the land itself."

Since then, counter-mapping has come to represent a range of efforts to wrest cartography from the claims to technocratic knowledge by the state and other dominant institutions. For example, Harris and Hazen (2006) embrace counter-mapping as a strategy to address the issues of how conservation efforts can serve to naturalize space. Their work suggests that by countering state-driven mapping of protected areas—through questioning the authority and limitations posed by a strictly territorial focus for conservation—local people can create more possibilities for community-designated and managed protected areas. Similarly, Rai et al. (2018) examined counter-mapping as a means of producing cultural sites in India for the Soligas tribe, particularly in connection to the Biligriri Temple Tiger Reserve. Given the tendency for conservation to become a form of primitive accumulation (e.g. Kelly 2011; see also; Büscher and Fletcher 2015), leading to the displacement of local people, counter-mapping is seen as facilitating a challenge to the dominant conservation management schemes.

While counter-mapping has numerous proponents, Joel Wainwright (2008) critiques it as potentially facilitating new forms of territorialization. New forms of power can be reproduced in the counter-mapping process that create new forms of exclusion. However, since critical cartography and counter-mapping question the unified, normalizing vision of mainstream mapping, we suggest that these approaches have potential to disrupt the distancing "god trick" (Haraway 1988) vision of food deserts and to help community food mappers reclaim the mapping process.

Community asset mapping

Community asset mapping situates the mapping process within communities themselves. This alternative mapping approach emerged in the mid-1990s as a tool for communities wishing to identify their key social, cultural, economic, and environmental assets. Jakes et al. note that Kretzmann and McKnight (1993), who initially proposed asset mapping, challenged community development practitioners to "reframe communities as places full of strengths and assets, instead of defining them as places with needs and deficits" (Jakes et al. 2015, p. 3; see also; Mathie and Cunningham 2003; Blevins et al. 2012). Alevizou (2015), drawing from Bourdieu's work on various forms of social and cultural capital, notes the ways that asset mapping "… enable[s] participants [to] generate shared visions about their projects, discuss what they like and what they like to change in their localities, and exchange ideas about how to co-develop outputs…" The community asset mapping process typically unites a diverse array of participants who understand how specific assets might be mobilized in their communities, as well as how particular assets might be connected through social and physical networks. Asset mapping engages community members directly in identifying their unique resources, as well as needs and challenges. This

action-oriented frame aims to catalyze, mobilize, and sustain community transformation.

Aldred (2011) cautions that asset mapping's efficacy can be hindered by failing to account for power inequalities among participants, or by eliding entrenched structural injustices in favor of oversimplified "empowerment" approaches. Nevertheless, as a participatory process, asset mapping elevates community members—rather than outside interveners—into leadership when telling stories of their places. Scorza, et al. (2012) note the potential merits of community-based asset mapping within food justice work, suggesting:

> [While] community-based organizations may be accustomed to presenting the needs and challenges their communities face, increased focus on community asset mapping can both strengthen existing work and provide new ways of understanding the issues that the food justice movement confronts… (Scorza et al. 2012, p. 5).

While community asset mapping has not been widely adopted in the food access literature, some notable studies have taken care to represent some overlooked assets alongside injustices in specific communities. Short et al. (2007), for example, showed how corner markets in San Francisco's Mission District were assets to community members there. Similarly, though Raja et al. (2008) found racial disparities related to supermarket access in Erie County, New York, they also found extensive networks of smaller markets in neighborhoods of color. And Taylor and Ard's (2015) sweeping analysis of Detroit's food accessibility catalogues extensive community assets overlooked by the USDA food desert map, including:

> 1,110 small groceries, convenience stores, mini marts, and liquor stores; 279 specialty food stores; 306 pharmacies, dollar, and variety stores; 1,245 full-service and fast food restaurants and other food service outlets; 157 supply chain operations; 206 farms, community and school gardens, farmers' markets, and produce markets; and 100 food assistance programs (Taylor and Ard 2015, p. 102).

The extensive nature of Taylor and Ard's study underscores the limitations of mainstream deficit-oriented food desert maps and framing, as well as the potential for alternative food access maps to incorporate community assets in addition to deprivations. In the Detroit case, researchers counted twice as many urban farms as full-sized grocery stores, and over ten times as many smaller grocery markets. Asset mapping also often proves more sensitive to "community voice" by visualizing food access resources, thereby generating more multifaceted representations of community food systems.

Participatory GIS

Similar to asset mapping, participatory GIS aims to produce maps that emphasize emic rather than etic perspectives. As such, "participatory mapping [also] serves as counter-mapping, displaying different claims and entitlements that are not present in the predominant discourse" (Heesen et al. 2014, p. 80). With participatory mapping, visual narratives that better represent community perspectives can be achieved more directly through tools that place mapping in the hands of community members. Christine Dunn (2007) contrasts conventional and participatory GIS by describing how the latter avoids a technocratic vision of place:

> Variously labeled as, *inter alia*, Participatory GIS (PGIS), Public Participation GIS (PPGIS), and Community integrated GIS…Participatory GIS celebrates the multiplicity of geographical realities rather than the disembodied, objective and technical 'solutions,' which have tended to characterize many conventional GIS applications (Dunn 2007, p. 616).

Participatory GIS tools and technologies can also foster collaboration and allow inclusive, creative approaches to visualization. As Van Wart and Parikh (2013) explain, "…GPS-enabled smart phones, open geospatial standards, free and publicly available geo-location, visualization, and data APIs, and the new geo-tagging capabilities of social media, have created an enabling infrastructure…" (Van Wart and Parikh 2013, p. 1). For example, "Local Ground," a participatory mapping web platform developed by Van Wart and Parikh, supports the collection and georeferencing of hand-drawn images, photographs, sounds, and videos, and quantitative data. This tool and others like it, such as crowd-sourced mapping platforms and open-source mapping apps, can support alternative food access mapping approaches that privilege community-sourced rather than outside interventionist visual narratives.

Community food access mappers might begin the participatory GIS mapping process with new geospatial tools by capturing tacit observations of their foodscape through drawings, pictures, audio interviews, paper notes, and mobile phones, using their own data collection tools. This qualitative data can be coded, and the resulting visual narrative can take a variety of forms, from traditional GIS to web-based maps to hand-drawn cartographic maps to photo-voice and more. Maps may also include embedded ethnographic interviews, audio recordings, or videos that deliver a fuller picture of a community food system, beyond oversimplified, decontextualized food desert maps.

Radical cartography

One commonality between creating art and mapmaking is the need to edit and refine both the art and the map conceptually and materially. In *Rethinking the Power of the Map* (2010), Denis Wood combines both into "map art" and explains, "Map art doubts the certainties of the map, and this creates a space for rethinking the map, for unmaking it." (Wood 2010, p. 8). Radical cartography offers a conceptual approach that allows the "rethinking" and "unmaking" of maps, either to disrupt conventional maps entirely, or to bridge gaps between conventional maps and community-based representations.

As Heesen et al. (2014) explain, "Map-making always involves making choices about what will be represented and what will not. However, the ontologies upon which geo-information systems are based often remain invisible, and are often not questioned by the users" (Heesen 2014, p. 75). As discussed, illuminating and questioning cartographic choices and partialities embedded in maps has given rise to counter-mapping, as a means to challenge power hierarchies. Radical cartography similarly challenges various epistemological authorities, functioning subversively to "actively promote social change" (Bhagat and Mogel 2007, p. 6). As the maps of radical cartographers Bill Rankin, Alexis Bhagat, and Lize Mogel demonstrate, employing a radical cartography lens makes it clear that maps are based in power. For example, Bhagat and Mogel describe,

> The simplest of radical cartographies, [is] the "upside-down" world map… the modern north-oriented map continually reproduces the idea of the global North and the global South. The "inverted" map calls into question our ingrained acceptance of this particular "global order." [Radical cartographic maps] unhinge our beliefs about the world, and… provoke new perceptions of the networks, lineages, associations and representations of places, people and power (Bhagat and Mogel 2007, p. 6).

In an apt analogy, Denis Wood describes maps as engines that convert social energy into social space, social order, or knowledge—not as a representation of the world but as a tool for creating it (Wood 2010, p. 1). Radical cartography, then, presents a framework to reveal fundamental inequalities, using the "engine" of the map to visualize *and* create new worlds (see also Denil 2011; Rankin 2016). We suggest that such a framework can help inspire a reimagining and recreation of food desert mapping.

Case description: providence food justice mapping project

Our interest in food desert mapping emerged from a course-based research project that spanned three-and-a-half years, involved participation by nearly 300 students, and aimed to characterize the Providence, Rhode Island "foodshed." Modeled initially—and loosely—after the Maryland Food System Mapping Project, the "Providence Foodshed Justice Project" explored the opportunities for and barriers to a more sustainable, equitable agrifood system within Providence's metropolitan area. Project deliverables included multiple student theses, research reports, an interactive public art installation attended by hundreds of community members, and a website with local imagery, resources, interviews, and maps. As one component of this larger project, we created a Providence food access map.

During the first year of the Providence Foodshed Justice Mapping Project, the USDA released its first Food Desert Locator. We were initially captivated by the scale, scope, and novelty of this sweeping GIS-driven visualization of food injustice. Yet as we reviewed the USDA map and compared it to familiar Providence neighborhoods, we noticed some puzzling misalignments. For example, some neighborhoods we knew to have plentiful food access in the form of smaller groceries and beloved local bodegas appeared on the USDA map as food deserts, while several other neighborhoods with a very narrow range of food options were outside the designated desert zone. This motivated us to learn the degree to which the USDA Food Desert Locator map was an accurate representation of Providence's food access, as well as how the map might change if local food assets—including smaller markets and bodegas, community gardens, farmer's markets, and food pantries—were included. We wondered: Could we create an alternative food desert map of Providence that would enable more nuanced understandings of food access injustice?

Methods

To examine this question, we designed a pedagogical exercise to collectively explore the spatial contours of food access in Providence. We asked students to envision grocery shopping with a hypothetical supplemental nutrition assistance program (SNAP) budget—each in a different local Providence neighborhood. Using the USDA's Thrifty Meal Plan toolkit, students in the course visited area stores with a market basket grocery list. We drew initial inspiration for this exercise from Short et al. (2007), who conducted market basket surveys in San Francisco and Oakland.

We selected thirty-nine stores throughout Providence, using Google Maps search tools to identify stores across the city with a random distribution. Rather than focus on USDA food desert neighborhoods exclusively, we sought a more comprehensive overview of food access. We randomly assigned students a corner market, bodega, or supermarket through an alphabetized list, and then provided each student

with written instructions, an in-class explanation, and a template spreadsheet of the market basket survey. Each student visited an area store and recorded how many food items, as well as the price of each item, from the USDA market basket list were available at selected markets. Shopping lists were generated from the USDA Thrifty Meal Plan (see Cohen 2002). The Thrifty Meal Plan suggests a shopping list for families on a limited budget, allowing a low-income family of four to maximize the SNAP budget while meeting basic recommended nutritional needs (Cohen 2002).

Students completed surveys on individual trips to selected stores, and the data were added to spreadsheet templates that calculated and summarized findings. Limitations for these study methods include potential inconsistencies associated with thirty-nine student researchers completing the market basket survey component of the research. We addressed any possible irregularities by responding thoroughly to inquiries about the survey process and reviewing and verifying survey results. When we discovered gaps or inconsistencies in the data, we addressed those on a case-by-case basis and made necessary corrections.

After compiling the data, we divided the total number of market basket survey items found at each store by the total number of items on the market basket list, creating a value that represents the percentage of a Thrifty Meal Plan market basket that shoppers could find at the surveyed store. Survey results were then analyzed by calculating the total cost of the market basket and the total number of Thrifty Meal Plan list items found in each store. We estimated the cost of a complete market basket from each store by proportionally adjusting the cost of the number of items reported in the survey; we then calculated the percentage of available Thrifty Meal Plan items. We used these numbers as a quantitative layer on our first food access map, displayed with a color gradient to show the availability of a Thrifty Meal Plan (see Fig. 1).

As we developed the first map, we also began gathering inspiration from the range of alternative mapping approaches previously described. In what became an iterative process throughout the project, we combed through map books, reviewed alternative mapping articles, analyzed alternative visualizations, and assessed numerous food desert mapping efforts. Increasingly, we lamented the limitations of mainstream GIS for capturing and visualizing the nuanced narrative of Providence food access that we sought. Moreover, in conversations with community partners within area food organizations, we heard repeatedly how mainstream GIS-driven maps were seen as visually unappealing and inaccessible to non-experts. This reinforced our sense that employing mainstream GIS exclusively would foster a top-down view of Providence's foodscape divorced from a more community-sourced vision.

Drawing upon these insights from community partners, and inspired and informed by our readings and investigations into alternative mapping practices, we created the second iteration of our map. To this second map we added important community food resources, including farmer's markets, community gardens, food pantries, and soup kitchens. Next, results from this exercise were overlaid onto a map that refined USDA food desert guidelines to an urban scale. For this iteration of the map (see Fig. 2), we then utilized graphic design tools to visually enhance the surface layers of the map, combining artistic renditions and interpretations into an increasingly textured representation of the Providence foodscape.

As we joined tools from the fields of visual art and cartography, we were particularly inspired by innovative radical cartographers Jensen and Roy (2012) and Solnit (2010), the latter of whom said, when explaining her approach to her creative atlas of San Francisco, "Cartography used to be both an art and a science." We also observed, when creating our own map art, how both mapmaking and creating art involves an inherently selective process in the display of information (e.g. see Harmon and Clemans 2009). For as the Providence food access map became more complex and textured, we saw that although GIS tools may allow for the visualization of multiple layers, the selection of what layers to include and exclude renders many aspects of food access invisible. We chose with our new map (see Fig. 2) to illuminate a visually rich food terrain that contrasts with the minimalist aesthetics of conventional GIS food desert maps. Jess coined the term "food topography" to describe the city's distinct differences in food access and as a conscious departure from the stigmatizing moniker, "food desert." The resulting "Providence Food Topographies Map" represented the culmination of multiple dialogues—with class members, community partners, the alternative mapping literature, and the authors themselves—as we sought to reimagine Providence food access.

Results

Alternative food access topographies

The first map we created from the market basket survey exercise (Fig. 1) showed a range of 33–95% of available items from the Thrifty Meal Plan shopping list. These results show a color-coded visualization of diverse brick-and-mortar retail grocery access in Providence. By illuminating and comparing the options offered when smaller stores were added to the map, we found, similar to Short et al. (2007), that smaller corner stores and bodegas "meet many of the criteria for community food security (CFS) by providing a wide variety of relatively low-cost foods," while recognizing they are not a "panacea" (Short et al. 2007, p. 352–353). This first map enhanced our understanding of local food access by adding

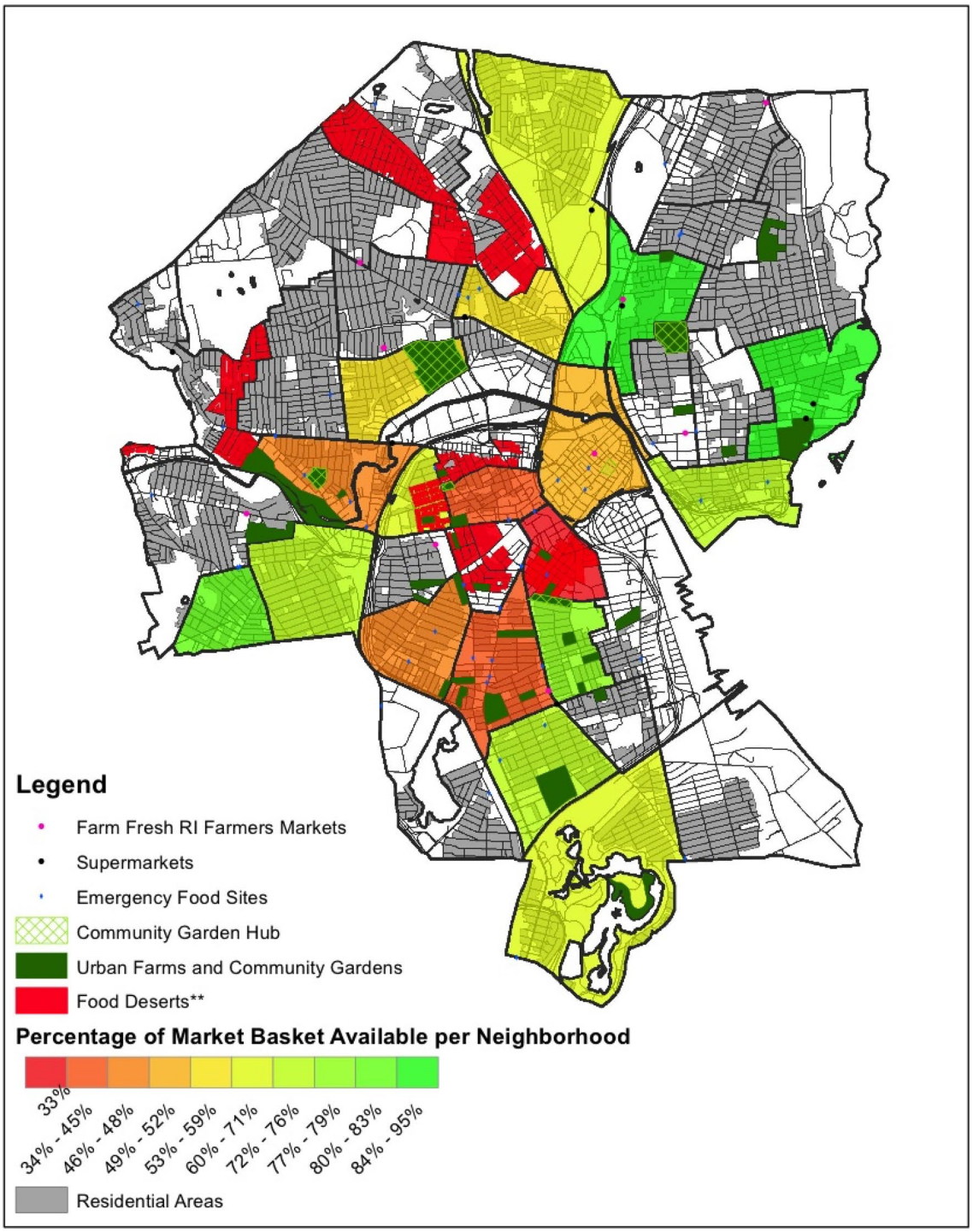

Fig. 1 Randomized sample Market Basket data using the Thrifty Meal Plan from the USDA Community Food Security Toolkit at Providence, RI stores. Map visualization: Daniels (2013). *Note* "Food Deserts" defined as block groups where > 33% of households are below 150% of poverty, > 25% households with no vehicle, and > 0.25 miles from a supermarket

smaller markets—important community assets that had been excluded by the USDA Food Desert Locator map.

Yet as our own critique of the deficit gaze of mainstream food desert mapping also began taking shape throughout the iterative mapping process, we recognized that our first map failed to fully capture the many complex ways that community food provisioning takes place. So, in the Providence Food Topographies Map (Fig. 2), we enhanced the

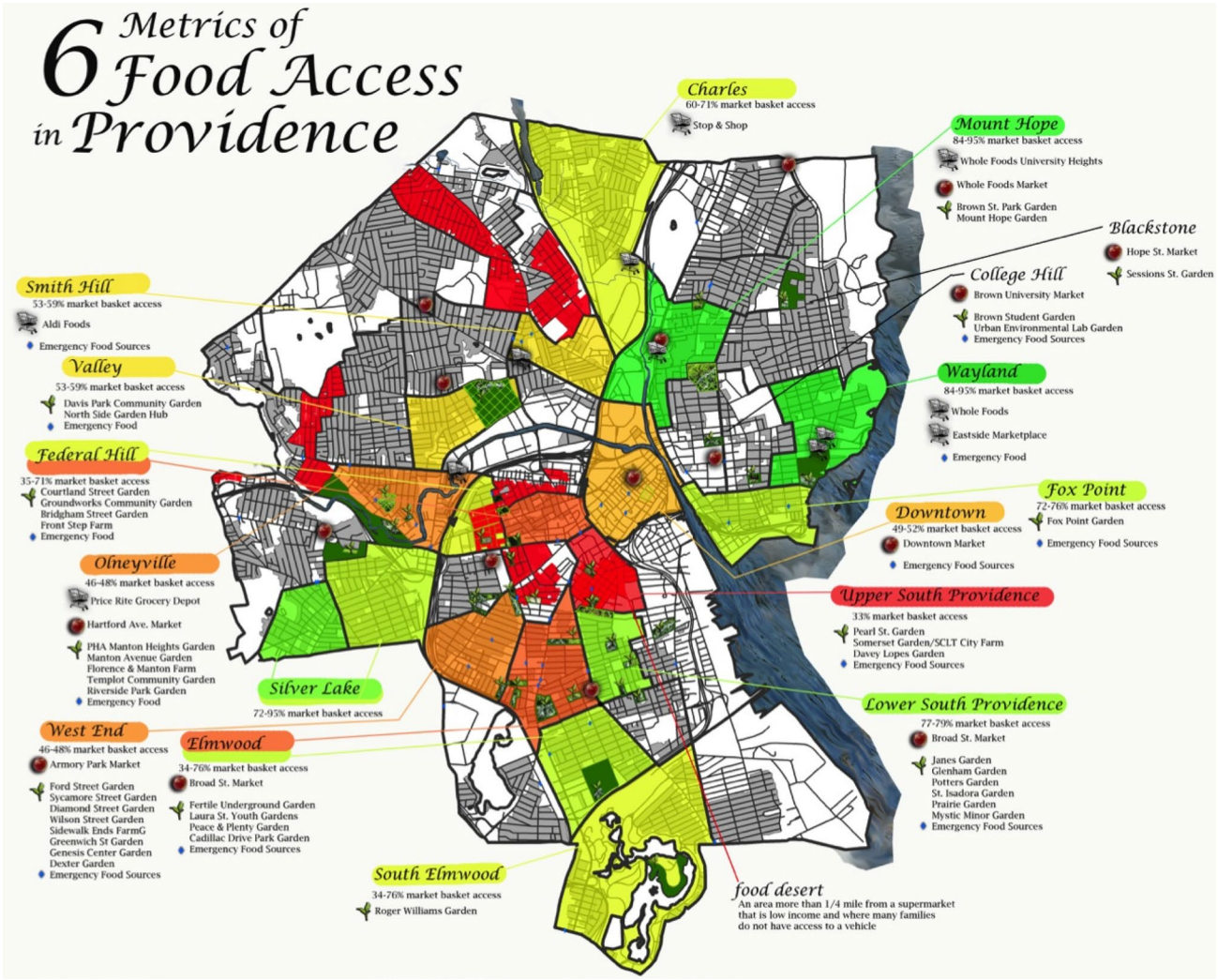

Fig. 2 Providence Food Topographies Map. Map visualization: Daniels (2013)

understanding of food access through the inclusion of community gardens, urban farms, farmer's markets, and emergency food sources. Textual labels represent neighborhood names as listed by The Providence Plan "Neighborhood Profiles" (2012). The market basket availability is represented on a visual scale of limited (red) to lush (green) food access, and the food source icons complement these depictions. Specific food sources in each neighborhood are listed below each of the neighborhood labels, cross-referenced via information gleaned from two local organizations, the Providence Community Growers Network and Farm Fresh Rhode Island.

The resulting map shows areas with limited food access, but—importantly—these areas do not appear as uniform deserts. Rather, the food landscape, as explored through layered data collection, appears as a dynamic, textured, densely populated topography, with areas that reach peaks of food access and are lush with a variety of options, as well as valleys that dip below measured levels of food access. The six metrics we used to assess food access, as identified in the map legend, include (1) "food deserts," assessed with urban-scale metrics (2) Market Basket data, (3) community garden hubs, (4) urban farms or community gardens, (5) emergency food sources, and (6) farmer's markets. These are displayed within the Providence landscape alongside community features such as parks, gardens, and public transportation. This situates food access in the context of a broader sociocultural, political and ecological picture. As we incorporated artistically rendered images of the local watershed to visually enhance this map, we considered carefully the feedback from community partners who lamented the inaccessible and unappealing nature of mainstream GIS maps.

When we compared and contrasted the Providence Food Topographies Map (Fig. 2) with the standard USDA Food Desert Locator, we found substantial differences. By using the market basket surveys to measure food access rather

than the nationally standardized indicators of distance to a large supermarket and vehicle availability, a far more multidimensional, contextualized, and nuanced picture of the foodscape began to emerge. For example, the USDA Food Desert Locator initially singled out only two tracts as food deserts and mapped exclusively at the census tract level. In our Providence Food Topographies map, we found limited food access in up to six census tracts.

We also mapped limited food access by neighborhood. Though both maps label Upper South Providence as areas with limited food access, the Providence Food Topographies Map also includes parts of Elmwood, the West End, Federal Hill, Olneyville, Mount Pleasant, Wanskuck, and Smith Hill. Though the Providence Food Topographies Map highlights and targets more areas lacking adequate food access than the USDA Food Desert Locator map overall, it does not include Washington Park, a census tract where, according to the USDA Food Desert Locator, 83.2% of residents have low access, and 13.2% of the population is low-income (Ver Ploeg et al. 2011). In these respects, the Providence Food Topographies map counters the underlying assumptions and data concerning food access of conventional food desert maps.

Critically, in addition to identifying overlooked areas that lack adequate food access (valleys), the Providence Food Topographies Map also details numerous assets (peaks) not recognized in the USDA Food Desert Locator that contribute to food access throughout Providence. A map depicting only deprivation, as is the case with most food desert maps, would fail to acknowledge the many community-based (and frequently community-initiated) strategies for food provisioning, thereby depicting residents as passive victims of their food environment. Instead, we aim with the Providence Food Topographies Map to visualize contradictions, as we highlight both the peaks of food availability and valleys of low access. In spite of the additional richness of this map, in the course of the mapping process, we also recognized some of the limitations of our study, and we reflect on these—as well as the strengths of this mapping process—in the discussion section that follows.

Discussion

We began our project with the query: How might we reimagine food desert mapping to better visualize food access, in ways that acknowledge spatialized injustices but also do not reproduce stigmas or sensationalize areas of deprivation? Gottlieb et al. have argued that food justice "seeks to assure that the risks and benefits of the food system are shared equally among all participants" (Gottlieb and Joshi 2010). And at first glance, food desert mapping seems like a clear-cut illustration of the distribution of risks (lack of food access is a food desert) and benefits (abundant food access is not a food desert). However, as we have shown, such a diametric representation of food access is limiting. In the process of mapping food access in Providence, we saw how applying alternative approaches to mapping food access can help harness diverse observations and inform creative visualizations. We suggest that such creative visualizations can inspire more textured understandings of community food access, disrupt stigmatizing deficit gazes, and invite community engagement.

As discussed, our project was inspired by four alternative mapping approaches: critical cartography and counter-mapping, community-based asset mapping, participatory GIS, and radical cartography. Similar to counter-mapping, our project interrogated the foundational premises of the authoritative food desert frame. In our first map, we questioned the veracity of the food access indicators upon which the initial USDA Food Desert Locator map was premised and redrew the map's food access boundaries after "ground truthing." Taking particular note of points of disjuncture, we asked: When did our data and findings not align with the USDA map's authority and underlying assumptions? Our efforts to counter-map did not extend to reclaiming actual geographic space, particularly given that both authors were transient members of the Providence community. Yet through our food topographies map, we countered the conceptual territory occupied by external, authoritative narratives. This process afforded us and our community partners a far more nuanced understanding of community food access that was more aligned with actual Providence food provisioning.

Our mapping project was also particularly inspired by the tenets of community asset mapping, and in framing our study we drew upon several notable studies that interrogated the deficit framing of standard food desert maps (e.g. Short et al. 2007; Raja et al. 2008). We asked, therefore: What were the silences of the conventional food desert map of Providence? What food access stories were absent? As we addressed these questions, we situated our visualizations in richer, textured understandings of community food access. We incorporated smaller markets and bodegas, community gardens, food pantries, and farmer's markets into our Providence Food Topographies map (Fig. 2).

Unearthing the previously buried assets of the standard food desert map enabled us to juxtapose Providence's resources against its food access disparities, and to disrupt singular visual representations of mapped spaces that can easily foster assumptions and stigmas about particular places, people, and diets. For not only is it an injustice that low income and ethnic minority neighborhoods lack adequate food access (Eisenhauer 2001; Treuhaft and Karpyn 2010), but it is a further injustice to stigmatize these places as bereft of any cultural, social, and community-driven resources and food-sourcing strategies. With our Providence

Food Topographies map, we argue that the visual and conceptual conversation around food access should move toward a more inclusive and nuanced view of the food environment that allows for comparative perspectives, visual contradictions, and better understandings of the local context.

With respect to participatory GIS, one aim of the larger Providence Food Justice Project was to foster community-engaged scholarship. With the Providence Food Topographies map specifically, we hoped to generate dialogues between academic researchers and Providence community members, affording opportunities for ongoing reciprocity. The differences between our initial aims and ideals around community-based engaged scholarship and our actual research experience proved illuminating and humbling. Although our project was inspired by participatory GIS methods, our experience fostering productive community dialogue throughout the mapping process was uneven. One challenge involved the data collection process. Some students reported awkward interactions with storekeepers who did not recognize the researchers as regular patrons. Though we spoke with storeowners in advance of our experiential exercise, and while some students engaged in fruitful conversations with storeowners and patrons while gathering data, other students described the research process as extractive. Navigating between immersive, participatory student learning and community participatory GIS was more complex than we anticipated.

Second, though our research allies included several supportive grassroots community partners, the mapping process nevertheless illuminated the sociocultural and economic gulfs between tightly networked university and advocacy groups, and the majority of Providence community members. We concluded that improving our aims of participatory GIS in future projects would entail embedding participatory elements throughout the entire mapping process, including the research design, data collection, visual representations, and dissemination. Nevertheless, reflecting on the tenets of participatory GIS encouraged us to dialogue with community partners, who offered valuable insights throughout the mapping process and enhanced our community engagement.

Finally, radical cartography inspired our efforts to examine food access conceptually and materially. Of course, the power relations embedded within the mapping process itself make it anything but objective. The artistic design and analysis of food access maps involved framing the visualization through various positionalities and "gazes." In their work analyzing *National Geographic* photography, Lutz and Collins (1991) identify and problematize several types of gazes. Drawing from feminist film theory, visual sociology, and Foucault's notion of the "normalizing gaze, a surveillance that makes it possible to qualify, to classify and to punish," Lutz and Collins demonstrate how "the position of spectator has the potential to enhance or articulate the power of the observer over the observed" (Lutz and Collins 1991, p. 135–36; Foucault 1977, p. 25). Lutz and Collins then illuminate how *National Geographic* photographs become "dynamic sites at which many gazes or viewpoints intersect" (Lutz and Collins 1991, p. 134).

As we apply these concepts to food access, we suggest that food desert maps—as graphic representations of socioeconomic and geopolitical plurality (Treuhaft and Karpyn 2010)—also chart the intersecting gazes about specific places. "Converging forces" meet at these dynamic sites (e.g., Solnit 2010, p. 8), with different voices and visions competing over the content and communication of foodscape narratives. Yet the conceptual contest over *how* these place-based narratives emerge is not apparent in most final food desert maps. We suggest that radical cartographic approaches to food access, by affording multiple ways of interrogating individual gazes (such as, for example, the normalizing gaze linked to mainstream GIS mapping), can visually challenge notions of spatial power. In our own mapping process, reflecting on the various voices and visions embedded in the Providence Food Topographies map encouraged us to begin shift our own gazes from "spectators" to "community members."

We also aim with the map to visually disrupt normalizing gazes with a range of dynamic colors and organic shapes that invite new perceptions and "unhinge our beliefs" (Bhagat and Mogel 2007). Whereas most standard food desert maps present only two conceptual and visual choices—adequate food access or deprivation—our food topographies map counters the diametric, oppositional nature of this metric. We soften the linear architecture of the GIS map, obfuscating the imposing deficit lens by incorporating an intimate intricacy into the map: a plurality of symbols, color gradients, and textural collages. Like radical cartographic maps, we intend to evoke a layered landscape that cannot be interpreted in a cursory glance. With our artistic departure from comparatively austere food desert maps, we underscore the idea that food access itself deserves a closer, longer look.

Conclusion

In the past 20 years, food desert maps have served the critically important function of illuminating and visualizing food access injustice. Yet we have argued herein that these maps, by design, overlook rich community resources. Scholars and activists have voiced ways that this fosters a deficit gaze toward individuals, communities, and places. Such a gaze has power to define food access narratives, presaging pre-figured solutions such as strategic corporate grocery store placements and other outside interventions. Hajer (1995, p. 22) has referred to such narrative power as "problem closure," which occurs "...when a specific definition of a problem is used to frame

subsequent study of the problem's causes and consequences in ways that preclude alternative conceptualizations of the problem." We contend that lack of food access is symptomatic of entrenched injustices, such as poverty, racism, and various forms of colonization, and addressing such "food apartheid" begins with Hajer's "alternative conceptualizations."

Our Providence case study shows how alternative mapping approaches—such as critical cartography and countermapping, community asset mapping, participatory GIS, and radical cartography—can contribute to reimagining food access and inspire nuanced, community-sourced visions of food justice. In our own mapping process, the new paradigm of "food topographies" supplanted the notion of food deserts. We highlighted the city's food access injustices when mapping metaphorical valleys, while also illuminating vibrant, rich food resources in its peaks. Embracing such contradictions in the same map can foster an ongoing dialectic—reflecting the tensions between injustice and the munificent social, cultural, and material resources that characterize diverse communities. Each peak or valley in our map invites viewers to seek out and listen to untold stories of each place, and to facilitate community-centered responses. To map a neighborhood's garden or corner market, for example, heeds those for whom these food-provisioning spaces are also beloved community *places*.

Re-imagining food access mapping and creating novel visualizations can also encourage the reimagining of *all* places as rich with nourishment, opening pathways to restoring narrative power to communities. This can inform grassroots mapping and action tailored to—and initiated from within—those communities. With our Providence Food Topographies map, we invite fellow mappers, researchers, policymakers, and community members to challenge the abstractions of food desert maps and cultivate creative, exploratory, and affectionate visions of our foodscapes.

Acknowledgements The authors gratefully acknowledge the contributions of the students of Brown University's "Sustenance and Sustainability" course and leaders of the Providence Foodshed Justice Project (http://pvdfoodshedjusticemapping.org/) to this work. We are especially thankful for contributions by Molly Bledsoe and Daniel Blaustein-Rejto, who contributed mapping information on Providence farmer's markets and food pantries. We also thank the dozens of Providence, Rhode Island storekeepers and employees who generously accommodated our experiential course-based exercise, and we are grateful to the Environmental Justice League of Rhode Island and the Rhode Island Food Policy Council for their helpful feedback at critical junctures of this project. Finally, we thank Brown University's Center for Environmental Studies, Swearer Center for Public Service, and Creative Mind Initiative for their support.

References

Aldred, R. 2011. From community participation to organizational therapy? World café and appreciative inquiry as research methods. *Community Development* 46 (1): 57–71.

Alevizou, G. 2015. Mapping assets within the media, community and the creative citizen project. Asset Mapping: Comparative Approach. http://comparativeassetmapping.org/?p=98. Retrieved 15 Oct 2015.

Alkon, A. H., D. Block, K. Moore, C. Gillis, N. DiNuccio, and N. Chavez. 2013. Foodways of the urban poor. *Geoforum* 48: 126–135.

Battersby, J., and J. Crush. 2014. Africa's urban food deserts. *Urban Forum* 25 (2): 143–151.

Beaumont, J., T. Lang, S. Leather, and C. Mucklow. 1995. Report from the Policy Sub-group to the Nutrition Task Force Low Income Project: Department of Health. Hertfordshire: Radlett Institute of Grocery Distribution.

Bhagat, A., and L. Mogel. 2007. Introduction. In *An atlas of radical cartography*, eds. L. Mogel, and A. Bhagat, 6–11. Los Angeles, CA: Journal of Aesthetics & Protest Press.

Bilková, K., and F. Križan. 2015. Mapping of grocery stores in slovak countryside in context of food deserts. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis* 63 (5): 1633–1638.

Blevins, J., S. Thurman, M. Kiser, and L. Beres. 2012. Community health assets mapping: A mixed methods approach in Nairobi. Mapping, cost, and reach to the poor of faith-inspired health care providers in Sub-Saharan Africa: Strengthening the evidence for faith-inspired health engagement in Africa, vol. 3, The World Bank: Washington, DC

Breyer, B., and A. Voss-Andreae. 2013. Food mirages. *Health & Place* 24: 131–139.

Brinkley, C., S. Raj, and M. Horst. 2017. Culturing food deserts: Recognizing the power of community-based solutions. *Built Environment* 43 (3): 328–342.

Brones, A. 2018. Karen Washington: It's not a food desert, it's food apartheid. In *Guernica*. https://www.guernicamag.com/karen-washington-its-not-a-food-desert-its-food-apartheid. Retrieved 12 Oct 2018.

Buczynski, A. B., H. Freishtat, and S. Buzogany. 2015. Mapping Baltimore city's food environment: 2015 report. Maryland Food System Map. http://mdfoodsystemmap.org/wp-content/uploads/2015/06/Baltimore-Food-Environment-Report-2015-11.pdf. Retrieved 6 Nov 2018.

Büscher, B., and R. Fletcher. 2015. Accumulation by conservation. *New Political Economy* 20 (2): 273–298.

Chen, X., and J. Clark. 2015. Measuring space–time access to food retailers: A case of temporal access disparity in Franklin County, Ohio. *The Professional Geographer* 68 (2): 1–14.

Cohen, B. 2002. USDA community food security assessment toolkit. USDA Economic Research Service: Electronic Publications from the Food Assistance & Nutrition Research Program. https://www.ers.usda.gov/webdocs/publications/43164/15824_efan02013_1_.pdf?v=0. Retrieved 9 Sept 2012.

Collier, J. Jr. 1967. *Visual anthropology: Photography as research method*. Foreword by George and Louise Spindler. New York, Chicago, San Francisco, Toronto, London: Holt, Rinehart and Winston.

Coveney, J., and L. O'Dwyer. 2008. Effects of mobility and location on food access. *Health & Place* 15 (1): 45–55.

Crampton, J. W., and J. Krygier. 2005. An introduction to critical cartography. *ACME* 4 (1): 11–33.

Cummins, S., and S. Macintyre. 2002. Food deserts-evidence and assumption in health policy making. *BMJ* 325 (7361): 436–438.

Daniels, Jessica. 2013. *Wondering in the desert: Context, cartography, and visions of an Alternative Food Desert*. Brown University: Providence, RI. Unpublished undergraduate thesis.

Denil, M. 2011. The search for a radical cartography. *Cartographic Perspectives*. 68: 7–28.

Dunn, C. E. 2007. Participatory GIS: A people's GIS? *Progress in Human Geography* 31 (5): 616–637.

Eisenhauer, E. 2001. In poor health: Supermarket redlining and urban nutrition. *GeoJournal* 53 (2): 125–133.

Elbel, B., A. Moran, L. B. Dixon, K. Kiszko, J. Cantor, C. Abrams, and T. Mijanovich. 2015. Assessment of a government-subsidized supermarket in a high-need area on household food availability and children's dietary intakes. *Public Health Nutrition* 15: 2881–2890.

Elwood, S. 2006. Beyond cooptation or resistance: Urban spatial politics, community organizations, and GIS based spatial narratives. *Annals of the Association of American Geographers* 96 (2): 323–341.

Fielding, J. E., and P. A. Simon. 2011. Food deserts or food swamps?: Comment on "Fast food restaurants and food stores. *JAMA Internal Medicine* 171 (13): 1171–1172.

Fields, T. 2013. [FOOD JUSTICE] End the Corporate Exploitation of 'Food Deserts'. *Ebony*, 3 April. https://www.ebony.com/health/food-justice-end-the-corporate-exploitation-of-food-deserts/. Retrieved 6 July 2018.

Figueroa, M. 2015. Food sovereignty in everyday life: Toward a people-centered approach to food systems. *Globalizations* 12 (4): 498–512.

Foucault, M. 1977. *Discipline and punish: The birth of the prison*. New York: Pantheon Books.

Galt, R. E. 2011. Counting and mapping Community Supported Agriculture (CSA) in the United States and California: Contributions from critical cartography/GIS. *ACME* 10 (2): 131–162.

Gillespie, G. W. 2003. Visual sociology and food. *Journal for the Study of Food and Society* 6 (2): 7–8.

Goldsberry, K., C. Duvall, P. Howard, and J. Stevens. 2010. Nutritional terrain mapping: A geospatial investigation of pedestrian produce accessibility. *GeoCarto International* 25 (6): 485–499.

Gottlieb, R., and A. Joshi. 2010. *Food justice*. Boston, MA: MIT Press.

Guminski, S. 2015. If you build it, they won't come: Why eliminating food deserts won't close the nutrition gap. *Chicago Policy Review*. http://chicagopolicyreview.org/2015/10/26/if-you-build-it-they-wont-come-why-eliminating-food-deserts-wont-close-the-nutrition-gap/. Retrieved 15 Oct 2015.

Guthman, J. 2008. Bringing good food to others: Investigating the subjects of alternative food practice. *Cultural Geographies* 15 (4): 431–447.

Guthman, J. 2011. *Weighing in: Obesity, food justice, and the limits of capitalism*. Berkeley, CA: University of California Press.

Hackett, A., L. Boddy, J. Boothby, T. J. B. Dummer, B. Johnson, and G. Stratton. 2008. Mapping dietary habits may provide clues about the factors that determine food choice. *Journal of Human Nutrition and Dietetics* 21 (5): 428–437.

Hajer, M. 1995. *The politics of environmental discourse: Ecological modernization and the policy process*. Oxford: Oxford University Press.

Handbury, J., I. Rahkovsky, and M. Schnell. 2015. What drives nutritional disparities? Retail access and food purchases across the socioeconomic spectrum. The National Bureau of Economic Research. https://www.nber.org/papers/w21126. Accessed 15 Oct 2015.

Haraway, Donna. 1988. Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies* 14 (30): 575–599.

Harmon, K., and G. Clemans. 2009. *The map as art: Contemporary artists explore cartography*. New York, NY: Princeton Architectural Press.

Harper, D. 1998. An argument for visual sociology. In *Image-based research: A sourcebook for qualitative researchers*, ed. J. Prosser, (pp. 24–41), London: Routledgefalmer.

Harris, L. M., and H. Hazen. 2006. Power of maps: (Counter) mapping for conservation. *ACME* 4 (1): 99–130.

Heesen, J., D. F. Lorenz, M. Nagenborg, B. Wenzel, and M. Voss. 2014. Blind spots on Achilles' heel: The limitations of vulnerability and resilience mapping in research. *International Journal of Disaster Risk Science* 5 (1): 74–85.

Herries, J. 2010. Mapping food deserts. Presentation for "Healthy Communities By Design" conference, Redlands and Loma Linda, California, pp. 15–17.

Horst, M., and B. Gaolach. 2015. The potential of local food systems in North America: A review of foodshed analyses. *Renewable Agriculture and Food Systems* 30 (5): 399–407.

Howard, P. 2009. Visualizing food system concentration and consolidation. *Southern Rural Sociology* 24 (2): 87–110.

Jakes, S., A. Hardison-Moody, S. Bowen, and J. Blevins. 2015. Engaging community change: The critical role of values in asset mapping. *Community Development* 46 (4): 392–406.

Jensen, D., and M. Roy, eds. 2012. Mission possible: A neighborhood atlas. http://missionpossiblesf.org/. Accessed 29 Oct 2015.

Kelly, A. B. 2011. Conservation practice as primitive accumulation. *The Journal of Peasant Studies* 38 (4): 683–701.

Kloppenburg, J. Jr., J. Hendrickson, and G. W. Stevenson. 1996. Coming into the foodshed. *Agriculture and Human Values* 13 (3): 33–42.

Kretzmann, J. P., and J. L. McKnight. 1993. *Building communities from the inside out: A path toward finding and mobilizing a community's assets*. Chicago, IL: ACTA.

Kwan, Mei-Po. 2002. Feminist visualization: Re-envisioning GIS as a method in feminist geographic research. *Annals of the Association of American Geographers* 92: 645–661.

LeClair, M. S., and A. M. Aksan. 2014. Redefining the food desert: Combining GIS with direct observation to measure food access. *Agriculture and Human Values* 31 (4): 537–547.

Leete, L., N. Bania, and A. Sparks-Ibanga. 2012. Congruence and coverage: Alternative approaches to identifying urban food deserts and food hinterlands. *Journal of Planning Education and Research* 32 (2): 204–218.

Lutz, C., and J. Collins. 1991. The photograph as an intersection of gazes: The example of National Geographic. *Visual Anthropology Review* 7 (1): 134–149.

MacNell, L., S. Elliott, A. Hardison-Moody, and S. Bowen. 2017. Black and Latino urban food desert residents' perceptions of their food environment and factors that influence food shopping decisions. *Journal of Hunger & Environmental Nutrition* 12 (3): 375–393.

Mathie, A., and G. Cunningham. 2003. From clients to citizens: Asset-based community development as a strategy for community-driven development. *Development in Practice* 13 (5): 474–486.

McClintock, N. 2011. From industrial garden to food desert: Demarcated devaluation in the flatlands of Oakland, California. In *Cultivating food justice: Race, class, and sustainability*, eds. A. H. Alkon, and J. Agyeman, 89–120. Boston, MA: MIT Press.

McEntee, J. 2009. Highlighting food inadequacies: Does the food desert metaphor help this cause? *British Food Journal* 111 (4): 349–363.

Minaker, L., P. Fisher, K. Raine, and L. Frank. 2016. Measuring the food environment: From theory to planning practice. *Journal of Agriculture, Food Systems, and Community Development* 2 (1): 65–82.

Mogel, L., and A. Bhagat, eds. 2007. *An atlas of radical cartography*. Los Angeles, CA: Journal of Aesthetics & Protest Press.

Morland, K., S. Wing, A. Diez Roux, and C. Poole. 2002. Neighborhood characteristics associated with the location of food stores and food service places. *American Journal of Preventive Medicine* 22 (1): 23–29.

Morton, L. W., E. A. Bitto, M. J. Oakland, and M. Sand. 2005. Solving the problems of iowa food deserts: Food insecurity and civic structure. *Rural Sociology* 70: 94–112.

Pavlovskaya, M. 2018. Critical GIS as a tool for social transformation. *The Canadian Geographer* 62 (1): 40–54.

Pavlovskaya., M. 2009. Non-quantitative GIS. In *Qualitative GIS: A mixed methods approach*, eds. M. Cope, and S. Elwood, 13–38. Thousand Oaks, CA: Sage.

Peluso, N. L. 1995. Whose woods are these? Counter-mapping forest territories in Kalimantan, Indonesia. *Antipode* 27: 383–406.

Peters, A. 2013. Change through food: Bringing an oasis to the West Oakland food desert. 1 March: GOOD: 1 March. https://www.good.is/articles/change-through-food-bringing-an-oasis-to-the-west-oakland-food-desert. Accessed 6 July 2018.

Pickles, John. 2003. *A history of spaces*. New York: Routledge.

Pollard, C. M., T. J. Landrigan, P. L. Ellies, D. A. Kerr, M. L. Lester, and S. E. Goodchild. 2014. Geographic factors as determinants of food security: A Western Australian food pricing and quality study. *Asia Pacific Journal of Clinical Nutrition* 23 (4): 703–713.

Rai, N. D., T. A. Benjaminsen, S. Krishnan, and C. Madegowda. 2018. Political ecology of tiger conservation in India: Adverse effects of banning customary practices in a protected area. *Singapore Journal of Tropical Geography*.

Raja, S., Changxing Ma, and P. Yadav. 2008. Beyond food deserts: Measuring and mapping racial disparities in neighborhood food environments. *Journal of Planning Education and Research* 27 (4): 469–482.

Rankin, William. 2016. *After the map: Cartography, navigation, and the transformation of territory in the Twentieth Century*. Chicago, IL: University of Chicago Press.

Rose, G. On the need to ask how, exactly, is geography "visual"?. *Antipode* 25: 212–221.

Rose, D., J. N. Bodor, C. M. Swalm, J. C. Rice, T. A. Farley, and P. L. Hutchinson. 2009. Deserts in New Orleans? Illustrations of urban food access and implications for policy. University of Michigan National Poverty Center/USDA Economic Research Service Research "Understanding the Economic Concepts and Characteristics of Food Access.".

Saletan, W. 2008. Food apartheid: Banning fast food in poor neighborhoods. *Slate*. Accessed 31 July 2008.

Sbicca, J. 2012. Growing food justice by planting an anti-oppression foundation: Opportunities and obstacles for a budding social movement. *Agriculture and Human Values* 29 (4): 455–466.

Scorza, D., N. Henderson, and L. M. Castillo. 2012. Facilitating change in the food justice movement. *Social Justice Learning Institute & People's Grocery*, http://sjli.org/sites/default/files/PG_and_SJLI_Final_Paper.pdf#overlay-context=program/health-equity/research-and-resources. Accessed 6 July 2018.

Shannon, J. 2014. Food deserts: Governing obesity in the neoliberal city. *Progress in Human Geography* 38 (2): 248–266.

Sheppard, E. 2005. Knowledge production through critical GIS: Genealogy and prospects. *Cartographica* 40 (4): 5–21.

Short, A., J. Guthman, and S. Raskin. 2007. Food deserts, oases, or mirages? Small markets and community food security in the San Francisco Bay Area. *Journal of Planning Education and Research* 26 (3): 352–364.

Solnit, R. 2010. *Infinite city: A San Francisco atlas*. Berkeley, CA: University of California Press.

Soss, J., R. Fording, and S. F. Schram. 2011. *Disciplining the poor: Neoliberal paternalism and the persistent power of race*. Chicago, IL: University of Chicago Press.

Sparks, A. L., N. Bania, and L. Leete. 2011. Comparative approaches to measuring food access in urban areas: The case of Portland, Oregon. *Urban Studies* 48 (8): 1715–1737.

Stallmann, T. 2012. Alternative cartographies: Building collective power. Master's thesis, Department of Geography. Chapel Hill, NC: University of North Carolina at Chapel Hill. https://www.tim-maps.com/static/stallmann-ma_thesis.pdf.

Taylor, D. E., and K. J. Ard. 2015. Food availability and the food desert frame in Detroit: An overview of the city's food system. *Environmental Practice* 17 (2): 102–133.

Tepper, R. 2011. D.C. mobile market bus to bring fresh produce to city's food deserts. The Huffington Post, 15 September. http://www.huffingtonpost.com/2011/09/15/dc-mobile-market-bus-food-desert_n_962763.html. Accessed 5 July 2018.

The Economist. 2011. If you build it, they may not come: A shortage of healthy food is not the only problem. 7 July. http://www.economist.com/node/18929190. Accessed 6 July 2018.

The Providence Plan. 2012. Providence neighborhood profiles. http://local.provplan.org/profiles/index.html. Accessed 5 June 2012.

Thomas, C. 2011. Emanuel seeks to eliminate Chicago food deserts. ABC7 Local WLS-TV Chicago, 1 February. http://abclocal.go.com/wls/story?section=news/politics&id=7932706. Accessed 6 July 2018.

Thornes, J. E. 2004. The visual turn and geography (response to Rose 2003 intervention). *Antipode* 36: 787–794.

Todd, J., and M. Ver Ploeg. 2015. Restricting sugar-sweetened beverages from SNAP purchases not likely to lower consumption. *United States Department of Agriculture* http://www.ers.usda.gov/amber-waves/2015-march/restricting-sugar-sweetened-beverages-from-snap-purchases-not-likely-to-lower-consumption.aspx#.Vb5hcjBVikr. Accessed 15 October 2015.

Treuhaft, S., and A. Karpyn. 2010. The grocery gap: Who has access to healthy food and why it matters. PolicyLink and The Food Trust. http://thefoodtrust.org/uploads/media_items/grocerygap.original.pdf. Accessed 3 July 2018.

Van Wart, S., and T. S. Parikh. 2013. Increasing youth and community agency in GIS. GeoHCI Workshop, 27–28 April: Paris. http://tap2k.org/papers/vanwart-localground-geohci2013.pdf. Accessed 15 Oct 2015.

Ver Ploeg, M. 2009. Access to affordable and nutritious food: Measuring and understanding food deserts and their consequences. United States Department of Agriculture Economic Research Service.

Ver Ploeg, M., and V. Breneman eds. 2011. Food Desert Locator. United States Department of Agriculture Agriculture Marketing Service. http://www.ers.usda.gov/data-products/food-desert-locator/go-to-the-locator.aspx. Accessed 25 Nov 2012.

Ver Ploeg, M., P. Dutko, and V. Breneman. 2015. Measuring food access and food deserts for policy purposes. *Applied Economic Perspectives and Policy* 37 (2): 205–225.

Wainwright, J. 2008. *Decolonizing development: Colonial power and the Maya*. Malden, MA: Blackwell Publishing.

Walsh, S. C. 2011. Big retailers make pledge of stores for 'food deserts.' The New York Times, 20 July. https://www.nytimes.com/2011/07/21/us/21food.html. Accessed 6 July 2018.

Whelan, A., N. Wrigley, D. Warm, and E. Cannings. 2002. Life in a "food desert. *Urban Studies* 39 (11): 2083–2100.

Widener, M. J., S. Metcalf, and Y. Bar-Yam. 2011. Dynamic urban food environments: A temporal analysis of access to healthy foods. *American Journal of Preventive Medicine* 41 (4): 439–441.

Wood, D. 2010. *Rethinking the power of maps*. New York, NY: Guilford Press.

Wrigley, N. 2002. "Food deserts" in British cities: Policy context and research priorities. *Urban Studies* 39 (11): 2029–2040.

Wrigley, N., D. Warm, and B. Margetts. 2003. Deprivation, diet and food retail access: Findings from the Leeds "Food Deserts" study. *Environment and Planning A* 35 (1): 151–188.

Yaccino, S. 2011. In Chicago, Michelle Obama takes on 'food deserts'. The New York Times: The Caucus, The Politics and Government Blog of The Times, 25 October. https://thecaucus.blogs.nytim

es.com/2011/10/25/in-chicago-michelle-obama-takes-on-food-deserts/. Accessed 6 July 2018.

Kathryn Teigen DeMaster Ph.D., is Assistant Professor of Agriculture, Society, and Environment in the Department of Environmental Science, Policy, and Management at the University of California-Berkeley. She is a rural sociologist whose work emphasizes agriculture, rural development, and food justice/food sovereignty. Raised on a small farm in Northwest Montana, Kathryn has conducted research on organic farming transitions in Poland, as well as place-based products in the United States. Her current research projects focus on farmland access and financialization, diversified farming systems, the "disappearing middle" of US agriculture, and participatory mapping of community food systems.

Jess Daniels is the Director of Communications & Affiliate Programming for Fibershed, a nonprofit organization based in Northern California working to develop regional textile systems that connect wearers to the biological and social source of their clothing. She has a decade of experience working to strengthen community-scale food and fiber systems, from urban farming and education to sustainable agriculture advocacy campaigns and litigation. She holds a B.A. in Environmental Studies and Visual Art from Brown University, where her undergraduate thesis explored the veracity and visualizations of food deserts in Providence, Rhode Island.