Applied Geography 56 (2015) 83–94

Contents lists available at ScienceDirect

Applied Geography

journal homepage: www.elsevier.com/locate/apgeog

Habitat modeling for health sovereignty: Increasing indigenous access to medicinal plants in northern Maine, USA

Michelle Baumflek [a, *], Stephen DeGloria [b], Karim-Aly Kassam [c]

[a] Department of Natural Resources, College of Agriculture and Life Sciences, Cornell University, 111A Fernow Hall, Ithaca, NY 14853, USA
[b] Department of Crop and Soil Sciences, College of Agriculture and Life Sciences, Cornell University, 1014 Bradfield Hall, Ithaca NY 14853, USA
[c] Department of Natural Resources & American Indian Program, College of Agriculture and Life Sciences, Cornell University, 122 Fernow Hall, Ithaca, NY 14853, USA

ARTICLE INFO

Article history:
Available online

Keywords:
Habitat modeling and sociocultural parameters
Indigenous communities
Health sovereignty
Maliseet

ABSTRACT

Medicinal plants and fungi play important roles in the health of Maliseet people of northern Maine, USA. A critical aspect of exercising choice in health care for this community is the ability to locate and have access to these plants. Habitat suitability modeling is a form of geospatial technology that can enhance health sovereignty by identifying locations in which populations of medicinal plants can be conserved or established. However, use of this technology within indigenous communities has been limited. Focusing on the medicinal plant muskrat root, *Acorus americanus* (Raf.) Raf., we generate a habitat suitability model for eastern Aroostook County, Maine (1,055,653.659 ha) that also takes community needs into consideration. Drawing on participatory ethnographic data as well as environmental characteristics, our model combines ecological and sociocultural parameters to identify previously unknown populations of *A. americanus* that are accessible to tribal elders. Our model successfully predicted 95% of *A. americanus* locations in our field validation data set of ~71,000 ha. Results suggest that approximately 0.6% of our study area contains suitable habitat to plant muskrat root that could also meet tribal members' gathering needs for the future. Increasing the number of potential collection sites gives communities options for gathering, thereby enhancing health sovereignty. Broadly, our work suggests that, when done in partnership with communities, different forms of geospatial technology can be beneficial tools for efforts to promote health sovereignty.

Introduction

Health sovereignty refers to the ability of people to choose health care options that are socioculturally relevant and ecologically possible (Kassam, Karamkhudoeva, Ruelle, & Baumflek, 2010). For indigenous people around the world, being able to choose culturally appropriate health care is an assertion of their fundamental rights, as articulated in the United Nations Declaration on the Rights of Indigenous People (2008). Specifically, Article 24, Section 1 of the Declaration states that:

> Indigenous peoples have the right to their traditional medicines and to maintain their health practices, including the conservation of their vital medicinal plants, animals and minerals. Indigenous individuals also have the right to access, without any discrimination, to all social and health services.

Health sovereignty implies that people have agency over their health care choices. However, in many parts of the world, capacity to exercise health sovereignty has been severely limited by multiple factors including legacies of colonialism, social and political unrest, lack of access to health care facilities, and natural disasters (Kassam et al., 2010). At the same time, many indigenous communities have disproportionately high rates of disease and chronic illnesses (Stephens, Porter, Nettleton, & Willis, 2006). Specifically, within wealthy nations such as the United States and Canada, indigenous people experience cardio-vascular disease, diabetes and obesity at significantly higher rates than other members of these societies (Barnes, Adams, & Powell-Griner, 2010; Castor et al., 2006; Kirmayer, Simpson, & Cargo, 2003).

To address these disparities, many scholars and practitioners have recognized the need for culturally-appropriate health care options for Native peoples of North America (Hartmann & Gone,

* Corresponding author. Tel.: +1 207 540 4988.
E-mail addresses: mjb235@cornell.edu (M. Baumflek), sdd4@cornell.edu (S. DeGloria), ksk28@cornell.edu (K.-A. Kassam).

http://dx.doi.org/10.1016/j.apgeog.2014.10.012
0143-6228/

2012; Kirmayer et al., 2003; LaFramboise, Trimble, & Mohatt, 1990; Walls, Johnson, Whitebeck, & Hoyt, 2006). For the members of these indigenous communities, medicinal plants are often one component of larger health care systems, which also include biomedicinal options. However, in many cases, the ability to use medicinal plants has been compromised by historic losses of land, destruction of and diminished access to important plant habitats, and concerns over environmental contamination (Ginger, Emery, Baumflek, & Putnam, 2012), thereby impacting health sovereignty. Furthermore, health sovereignty is dependent on different types of knowledge (Baumflek et al., submitted for publication, Kassam, 2009). Specifically, knowledge about medicinal plants is relational; knowing how to gather, prepare and use plants it is often the result of hands-on interactions in a specific place. Therefore, loss of access to plant species is detrimental to retention of knowledge about plant use and ecology.

Across the United States, Native American communities are working to increase the availability of important medicinal plant species. This is evidenced through the creation of medicinal plant gardens on tribal lands, and propagation of certain species in tribal nurseries (Northwest Indian College, 2013; Squaxin Indian Tribe, 2013; White Earth Tribal and Community College, 2013). However, some people prefer to gather plant medicines in places they consider to be their natural habitat, in which case other alternatives to increasing medicinal plant availability must be pursued. Habitat suitability modeling is one tool that could enhance access to medicinal plants, thereby increasing indigenous health sovereignty.

Habitat suitability modeling is a well-recognized geospatial tool used in biological conservation efforts. Models combine relevant environmental variables with occurrence data to estimate the actual or potential distribution of a species and may be generated in many different ways (Elith & Leathwick, 2009), including through generalized linear and generalized additive models, empirical models (Store & Jokimäki, 2003) and maximum entropy models (Phillips, Anderson, & Schapire, 2006). Habitat suitability models have limitations related to application of the niche concept, model parameterization, sample size and evaluation (Araujo & Guisan, 2006; Wisz et al., 2008). Nonetheless by predicting species occurrence in a landscape, habitat models give agencies and decision makers data that informs the designation of protected areas, corridors, land easements, and regulatory practices (Larson, Thompson, Millspaugh, Dijak, & Shifley, 2004; Rondinini, Wilson, Boitani, Grantham, & Possingham, 2006), as well as anticipating the future effects of climate change (Lötter and leMaitre, 2014).

In addition to being useful for plant and animal conservation, habitat modeling can also benefit communities who wish to sustainably access and use plants (see Hurley, Halfacre, Levine, & Burke, 2008). However, models are typically centered around the ecological requirements of a species, or set of species, rather than the needs of people who find them important (Elith & Leathwick, 2009). By expanding the main focus of a habitat suitability model from the needs of a plant species to also include the priorities of a group of people, habitat modeling can offer communities a way to locate plant species of interest, in a manner that is suited to community needs.

Incorporating community needs is necessary to make informed decisions about management of sociocultural-ecological systems (Reed, 2008), including the sustainable use of plant populations (Ballard & Huntsinger, 2006). Accordingly, scholarship in the field of natural resource management has begun to advance participatory methods for more effective planning and monitoring (Ballard & Belsky, 2010; Shirk et al., 2012). This includes a suite of spatially-explicit techniques that identify diverse values people attach to land (Fagerholm and Käyhkö, 2009), contributing to planning of national forests (Brown & Reed, 2009), national parks (Brown & Weber, 2011), and identification of sociocultural 'hotspots' (Alessa, Kliskey, & Brown, 2008).

Furthermore, medicinal plants often contribute important provisional, regulatory and, notably for indigenous communities, cultural ecosystem services (Plieninger, Dijks, Oteros-Rozas, & Bieling, 2013). However, Daniel et al. (2012) conclude that incorporation of cultural services into Ecosystem Services research and policy is poor, and suggest that: 'In this context, useful biological assessment models will anticipate the relevant social contexts and provide outputs that can be useful inputs to social assessments; summary measures of biodiversity or gross productivity will generally not be sufficient' (Daniel et al., 2012, pg. 8816). Habitat models that also incorporate sociocultural concerns are poised to respond to this call.

Drawing on an example of the medicinal plant species muskrat root, gighaswes (*Acorus americanus* (Raf.) Raf.) in relation to the Houlton Band of Maliseet Indians, this paper demonstrates how habitat modeling that takes both ecological and sociocultural parameters into account can contribute to community health sovereignty.

Indigenous communities and geospatial technology

Scholarly attitudes towards the use of geospatial technologies within indigenous and other local communities have evolved over the last two decades (Dunn, 2007). Within indigenous communities of North America, a negative perception of GIS may also be grounded in the historical legacy of conquest, colonization and appropriation of land and resources that was enabled through settler mapping efforts (Kassam, 2009). In addition concerns have been voiced that use of GIS creates abstractions of reality that do not capture the complex, multidimensional nature of relations between indigenous people and their environments (Roth, 2009). Others emphasize that geographic knowledge within indigenous communities differs from Euroamerican conceptions, and that introducing GIS into indigenous communities could alter relationships within communities (Rundstrum, 1995). While this might indeed be true, such criticisms overlook two important aspects of the use of geospatial technologies within indigenous communities: the dynamic nature of culture and community agency. A widely-held perception of many indigenous cultures is the notion that they are static, and to be authentic, indigenous people need to maintain old customs (Jordan, 2008; Silliman, 2009). Arguing that indigenous people refrain from using certain modern types of technology because it might affect cultural practices is a continuation of this incorrect notion, which creates a false dichotomy between indigenous and non-indigenous ways of knowing. Agency is demonstrated as Native communities adopt GIS technologies for resource management that is consistent with their cultural agendas (eg. Quaempts, Schumacher, & Shippentower, 2014).

Responding to these earlier criticisms, recent applied and participatory research demonstrates that geospatial technologies such as GIS, though not without problems, can be tremendously beneficial to indigenous communities (Elwood, 2006). Furthermore, many of these efforts have explicit outcomes that seek to enhance indigenous sovereignty. The most common application of GIS in indigenous communities is participatory mapping. Sometimes referred to as counter-mapping (Peluso, 1995), or human ecological mapping (Kassam, 2009; McLain et al., 2013), maps are created by communities to describe their own relations with their habitat, cultural spaces and places, including attributes such as areas of resource use, hunting and fishing grounds, as well as identification of traditional homelands. These maps are often created as an alternative or response to state-produced maps, which frequently overlook certain types of land use and meaningful