Awareness is growing among demographers that space is an important component in population studies. Furthermore, spatial methods contribute to a better understanding of many topics of interest that are now growing in popularity in demography. Two areas of interest that I will discuss are population health, especially with regards to migration, and environment-population interactions. Spatial methods are inherently important in both of these subtopics and I offer my research as an example of their application in spatial demography, as well as a consideration of some of the problems and considerations associated with these new directions in spatial demography.

My dissertation research investigates malaria incidence and malaria parasite drug resistance in indigenous migrant populations along the Thailand-Myanmar border. The unique malaria epidemiological behavior in this region is attributable to several factors. One such factor is climate, as rain is important for the larval stage of the mosquito vectors of malaria. Another important factor is human migration. Whereas Thailand has been largely successful at eliminating malaria from most regions, malaria along international border areas has been difficult to control. Even when Thai authorities are able to eradicate malaria in the Thai population, there is heavy migrant traffic flowing to and from Myanmar (where there is almost no public health infrastructure). This region is also an epicenter for multidrug resistant malaria and, since malaria parasites can easily spread to other regions, the population health considerations of the Thai-Myanmar border area are important for many other regions.

Migration studies are inherently about space. The act of migration implies moving from one place to another and oftentimes the demographic processes that we are interested in are related more to this mobility rather than simply the demographic profile (age, sex, ethnic group, etc.) of the individuals involved. For example, in my research I have little reason to believe that specific ethnic groups are at risk of malaria infection simply because of their ethnic identity. However migration into or through specific regions is probably associated with elevated risk of infection.

Migration therefore demands a reconsideration of lived spaces. While demographers have been investigating contextual implications of lived space, defining those lived spaces has been problematic. Some researchers have noted that census tracts and neighborhoods, while important, may not adequately define the spaces in which people spend most of their time. In

the case of migrants, the space is likely to be much larger and more fluid than it is for non-migrants.

Studies into such contextual and/or spatial processes are plagued by methodological and ethical issues. Often migrants are the subject of ridicule and discrimination. They may therefore prefer to remain hidden and certainly may not want to be tracked. Beyond their personal concerns, there are also safety and legal concerns associated with identifying and tracking migrants. In an age in which we could literally strap GPS units on individuals and follow their movements across a landscape, there are some obvious ethical dilemmas to consider.

This brings me to what I think is an important question: Should I (we) want to track individuals that may not want to be tracked? Furthermore, are there other ways to get at the questions that we are interested in without actually tracking migrants? In my research, and in others as well, I would say that the issues surrounding migration are so important that it is in fact necessary to study migration pathways and patterns, but that we should err on the side of confidentiality for the vulnerable populations that we are studying. Perhaps one way to do this is to find indirect measures of migration.

One proposed method for measuring migration routes has been through the use of network analysis, human energetics research, and topographical maps. For example, given certain characteristics of a landscape (e.g., mountains, narrow points in rivers, etc.), a network model can be used to calculate the most efficient route from one point to another, controlling for energetic efficiency and distance. Archaeologists have recently been using this method in order to calculate most likely routes, then comparing the simulated routes to what they actually find in the archaeological record. In my research, it may be possible to use this method to see if most likely routes are geographically related to malaria hot spots. I am sure that there is a plethora of other possible ways to get at a better understanding of the spaces that migrants inhabit.

The growing interest in population and environment interaction is also inherently spatial in nature. In fact, if not for changes in places and spaces we may not be interested in this interaction at all. In ecological sciences researchers have been using remote sensing to measure changing environments. In some situations, changes in environments are directly related to changes in population health. Clearing forests for agricultural purposes has long been associated with an increase in mosquito-borne diseases because the changes in the environment (irrigation, increased standing water, etc.) can lead to increases in vector populations. Spatial demography has a special place in this area of research as we already have some tools (spatial regression and hierarchical models) and can borrow others (remote sensing, etc.) in order to quantify the impact of environmental changes on populations. As our tools improve, I expect more possibilities to open up in this arena.

However, there are also several limitations and problems to consider in environment and population studies. Perhaps one of the largest issues is scale. As an example, meteorological

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data are generally taken from various weather stations within a region but within regions meteorological patterns can be highly variable. Is it important to smooth the data from many weather stations across an entire region? Or should we use the raw individual station data in order to include the actual variation that occurs at a specific place? Which is better for measuring the impact on a population that inhabits and lives in an area that is much larger than a single weather station? Furthermore, while some factors are important in one region, the same factors may not be important in others. While increased rainfall can lead to higher malaria incidence in one place, in other places it will have no effect at all (for example, if there is no malaria in that region!) Once again, there is frequently a contextual component to what is important.

The recurrent theme of context leads me to Geographically Weighted Regression (GWR), a method that is growing in popularity among spatial demographers. GWR takes advantage of the rich data sets that are increasingly becoming available and provides a means of visually understanding the way that important predictors influence outcome variables. In my own studies this will be important as I will be able to map the changes in relationships between covariates and outcomes across different scales and geographical subregions. I expect that different covariates will be more or less important in different subregions. Perhaps an interesting dimension that could be added to GWR is the temporal scale. Overall, this is an area where I think that spatial demography will have a lot to offer regarding public health and policy. The few population health studies that have already been done with GWR have shown that different things matter in different places, context matters. This simple fact is important for efforts to (for example) eradicate malaria, because place-based interventions are therefore most likely to be effective.