# Using Hot-Spot Analysis to Target Women, Infant and Children Services

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# Overview

- Background
- Study Questions
- Methods
- Results
- Discussion

# Background: WIC

- Special Supplemental Nutrition Program for Women, Infants and Children (WIC)
  - Provides health education
  - Supplemental food vouchers
- Approximately 1 of 4 pregnant women and roughly 50% of all infants born in the U.S. participate in WIC
- Almost 51% of pregnant women enroll in WIC during 1st trimester
- In California, WIC agencies provide services locally to nearly 1.45 million women, infants and children each month at 650 sites.

# Background: Need for GIS and Spatial Analysis in Good Times and Bad…

- **"Association of Maternal & Child Health Programs Opposes Major Funding Reduction to Women, Infant and Children (WIC) Program"**
  - House Agriculture Appropriations Subcommittee marked up a FY 2012 Agriculture Appropriations bill and included an $832 million funding reduction
  - Up to 500,000 low-income women and children would be denied services
  - Spatial analyses can help monitor impacts over time

# Study Questions

- Where are statistically significant clusters of WIC eligible women* located California?
- Where do micro-level clusters of WIC eligible women exist within counties?

*WIC eligible women: Received MediCal during pregnancy (i.e., WIC eligible) but did not receive WIC services

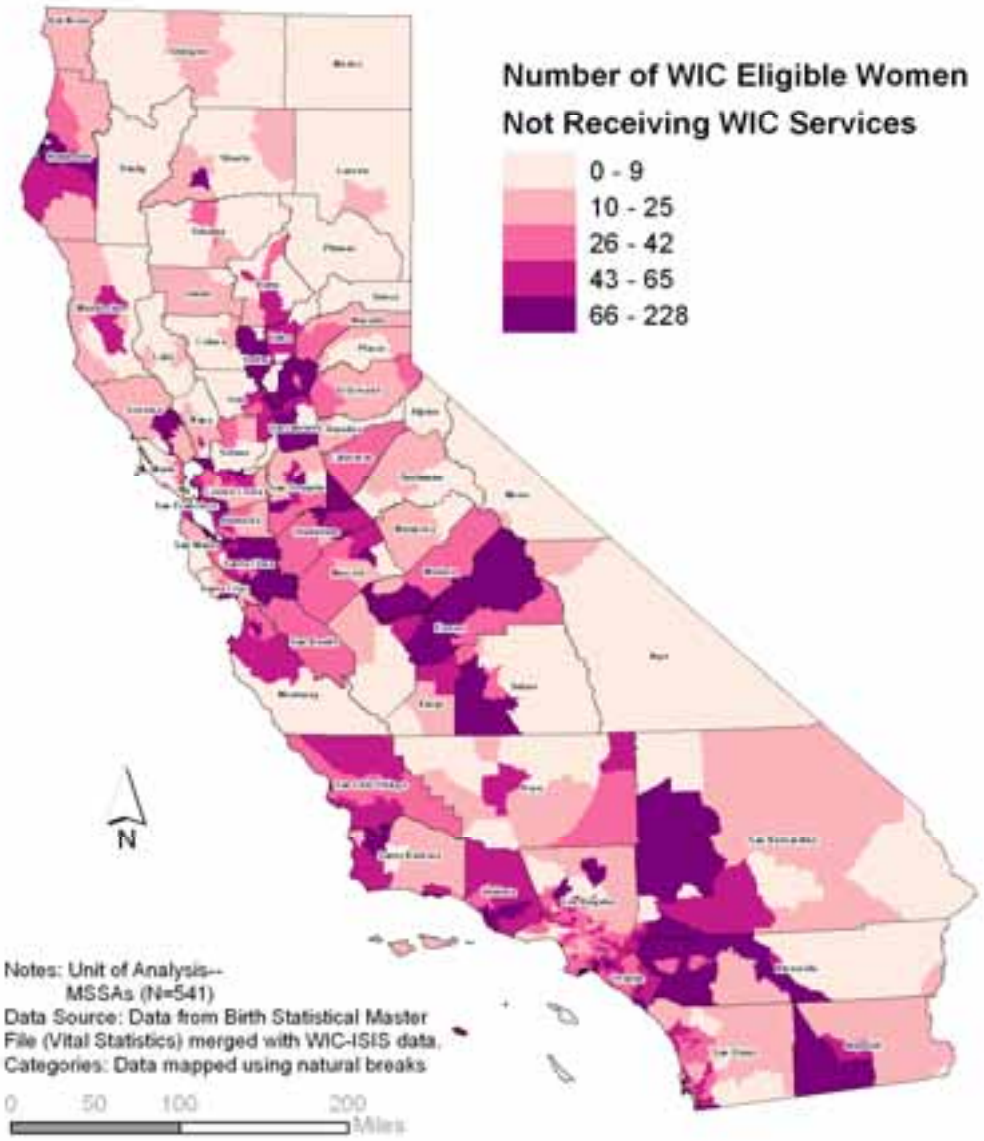
# Data

- Multi-step algorithm to merge 2 large data sets
  - Birth Statistical Master File for live births in CA in 2009 (N=518, 244)
  - 2009 WIC-ISIS data file (N=257,955)

- Outcome of interest:
  - Women on MediCal (i.e., eligible for WIC) but not receiving WIC services (N=23,147)

# Women on MediCal Not Receiving WIC Services

## California Medical Service Study Areas (MSSAs), 2009



# Questions:

- How do we know that these patterns are not due to chance alone?
- Where are statistically significant clusters of WIC eligible women located in California?
  - Hint: We need to conduct hot-spot analyses to find out!

# Methods: Hot-Spot Analysis

## Getis Ord Hot-Spot Analysis (Gi*)

- Spatial analysis tool
- Used to pinpoint locations of clusters
  - Looks at each feature within the context of neighboring features. A feature with a high value is a statistically significant hot spot if it is also surrounded by other features with high values.
  - The local mean for a feature and its neighbors is compared proportionally to the "global mean" of all features.
  - When the *observed* local mean is much different than the *expected* local mean, and that difference is too large to be the result of random chance, a statistically significant Z-score results.

# Methods: Hot-Spot Geoprocessing Tasks

1) Calculate area for polygons (e.g., census tracts) and select areas that are < 1.5 SD below the mean;

2) Find the appropriate spatial scale for selected tracts (i.e., distance from each tract to 2 nearest neighbors)
    - Starting Distance
    - Incremental Distance

# Methods: Hot-Spot Geoprocessing Tasks

3) Conduct incremental spatial autocorrelation analysis (Moran's I)

- Determine multiple distances at which clustering peaks
- Find distance of first statistically significant peak (Z-score; p-value)

4)Generate a spatial weights matrix file to assess the spatial connectivity of polygons (i.e., census tracts) included in analyses

5)Conduct hot-spot analysis

- Determine location of statistically significant clusters

# Methods: Hot-Spot Analysis

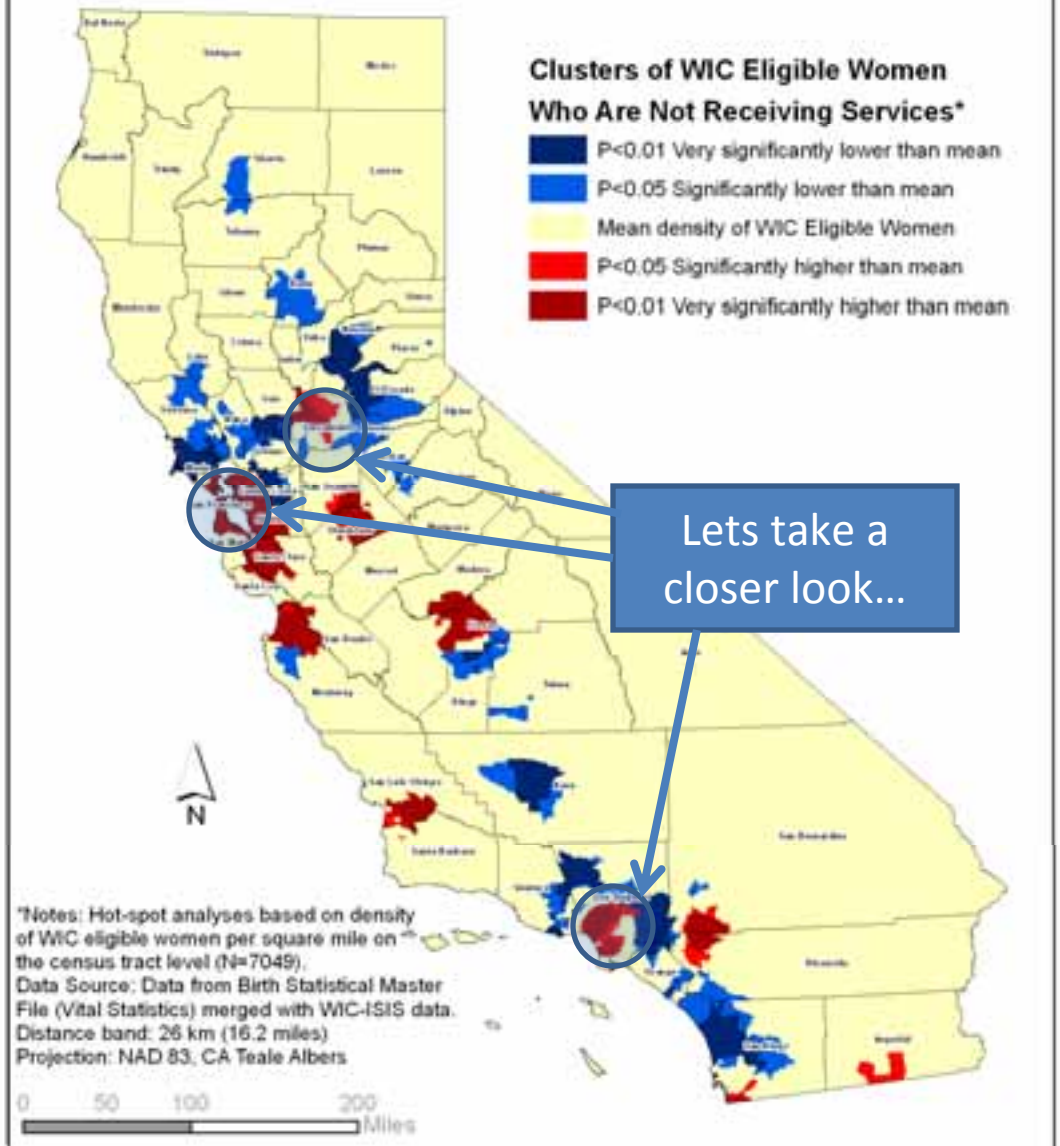
- Clusters we wish to pinpoint
  - Statistically significant clusters of WIC eligible women across the **state**
  - Significant clusters of WIC eligible women within selected **counties**

- Results
  - P-values and Z-scores (map layer)
    - Larger Z-score, more intense the clustering of high values (**a hot-spot**)
    - Smaller Z-score, more intense the clustering of low values (**a cold-spot**)

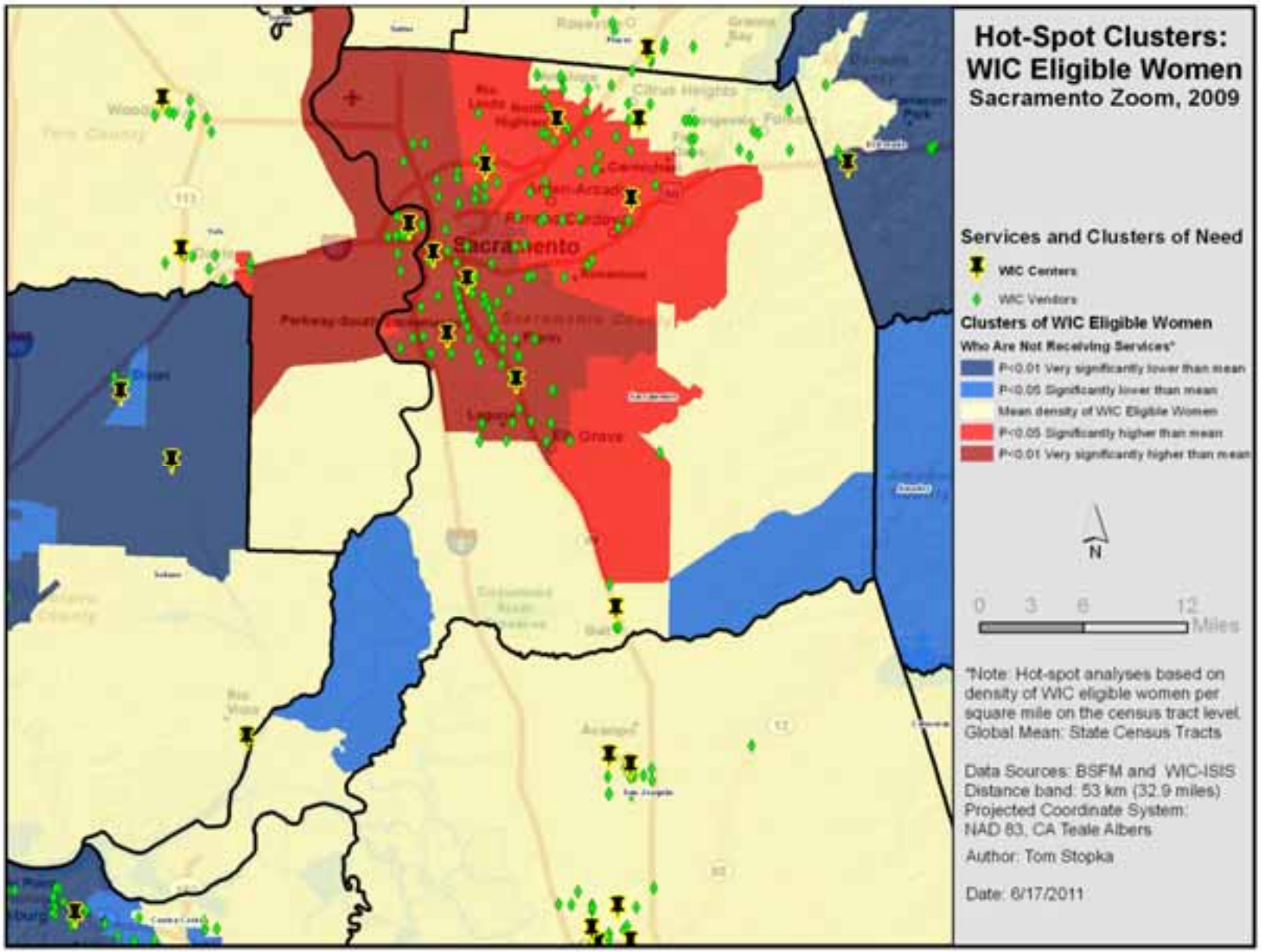
# Results: Statewide Hot-Spot Analyses

# Hot-Spot Clusters: Density of WIC Eligible Women

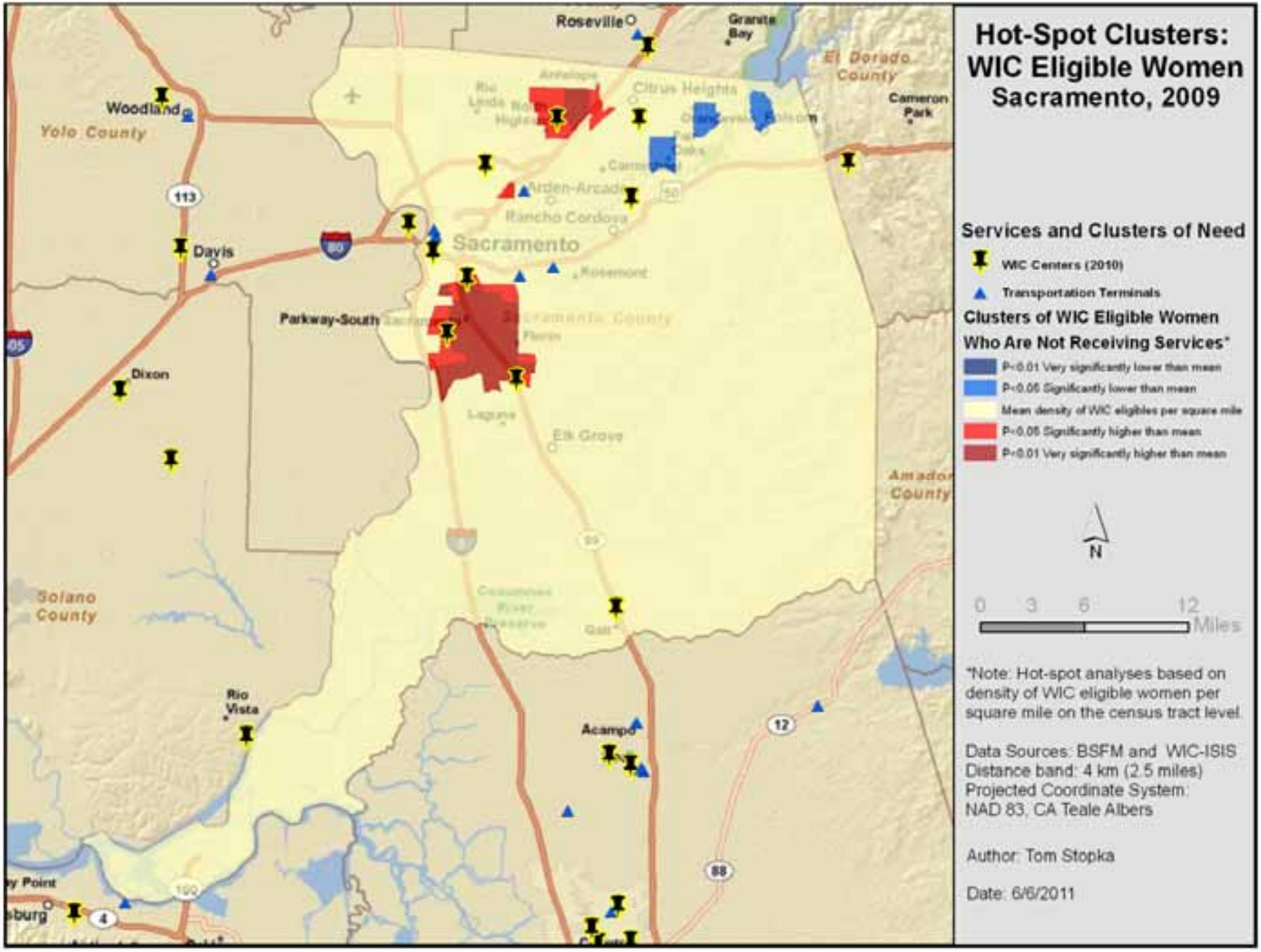
California Census Tracts, 2009

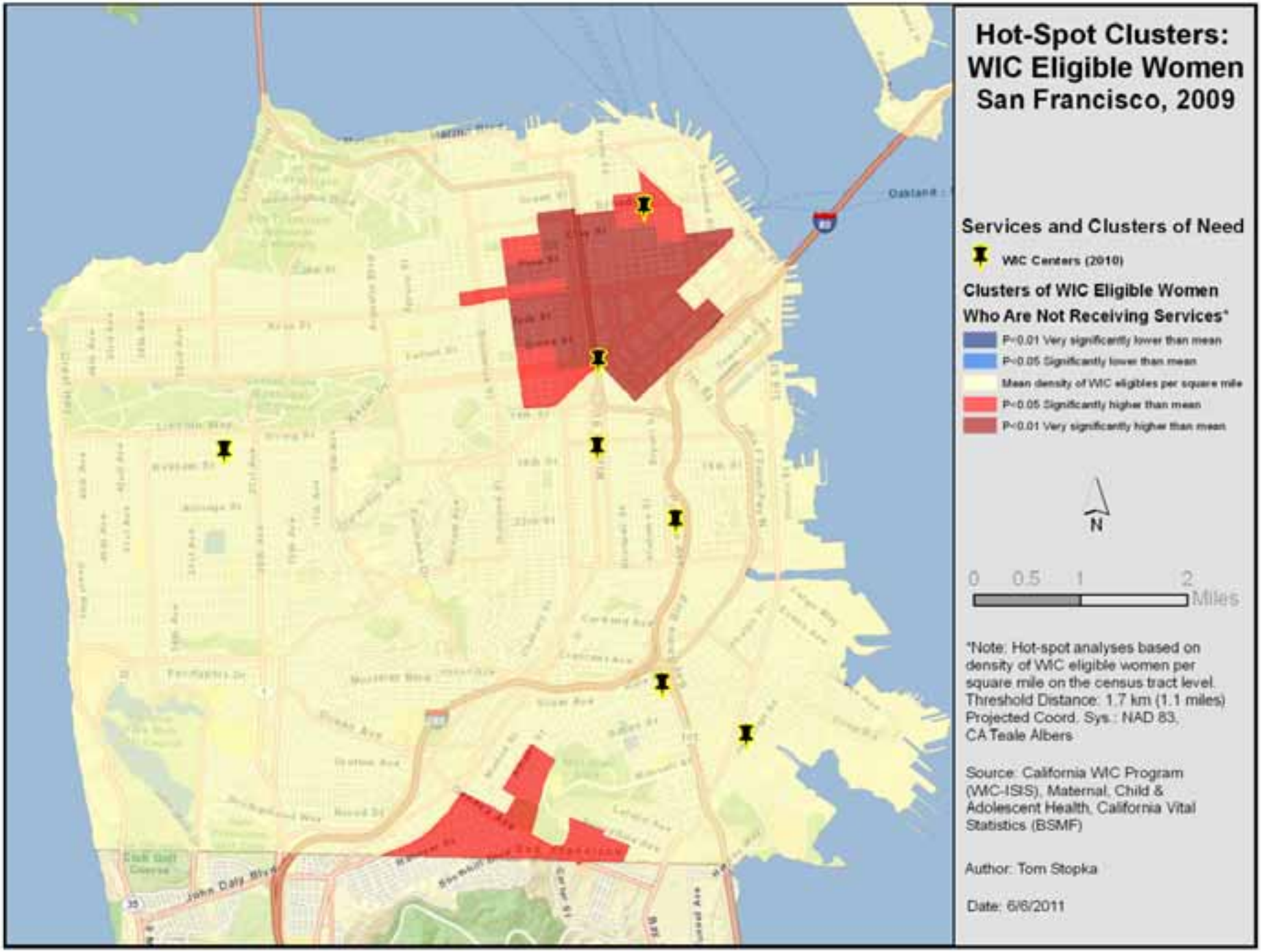


# Zoom to Sacramento



# Results: County-Specific Hot-Spot Analyses


Hot-Spot Clusters:
WIC Eligible Women
Sacramento, 2009
Services and Clusters of Need
WIC Centers (2010)
Transportation Terminals
Clusters of WIC Eligible Women
Who Are Not Receiving Services*
P<0.01 Very significantly lower than mean
P<0.05 Significantly lower than mean
Mean density of WIC eligibles per square mile
P<0.05 Significantly higher than mean
P<0.01 Very significantly higher than mean
N
0 3 6 12
Miles
*Note: Hot-spot analyses based on density of WIC eligible women per square mile on the census tract level.
Data Sources: BSFM and WIC-ISIS
Distance band: 4 km (2.5 miles)
Projected Coordinate System:
NAD 83, CA Teale Albers
Author: Tom Stopka
Date: 6/6/2011
Roseville
Granite Bay
El Dorado County
Cameron Park
Citrus Heights
Woodland
Yolo County
Davis
Sacramento
Rancho Cordova
Parkway-South
Dixon
Elk Grove
Solano County
Rio Vista
Acampo
Amador County


Hot-Spot Clusters:
WIC Eligible Women
San Francisco, 2009
Services and Clusters of Need
WIC Centers (2010)
Clusters of WIC Eligible Women
Who Are Not Receiving Services*
P<0.01 Very significantly lower than mean
P<0.05 Significantly lower than mean
Mean density of WIC eligibles per square mile
P<0.05 Significantly higher than mean
P<0.01 Very significantly higher than mean
N
0 0.5 1 2
Miles
*Note: Hot-spot analyses based on density of WIC eligible women per square mile on the census tract level.
Threshold Distance: 1.7 km (1.1 miles)
Projected Coord. Sys.: NAD 83, CA Teale Albers
Source: California WIC Program (WIC-ISIS), Maternal, Child & Adolescent Health, California Vital Statistics (BSMF)
Author: Tom Stopka
Date: 6/6/2011

# Results

- The 5 geoprocessing steps for hot-spot analyses provided a systematic, rigorous, and objective approach
- State level hot-spot analyses helped locate statistically significant clusters of WIC eligible women in key CA counties
- County level hot-spot analyses allowed us to locate clusters of highest WIC need on the local level
- Findings helped inform WIC program and funding decisions on the state and local level

# Discussion

- Limitations
  - Focused on women alone (not infants and children)
  - Time lag

- Public Health Implications:
  - Hot-spot analyses provided objective method to guide funding decisions
  - Similar analyses can be conducted for other programs to target services
  - Need for GIS and spatial analyses in good times and bad…

- Next Steps
  - Additional hot-spot analyses
  - Statistical modeling
  - Analyses of WIC eligible infants and children

# For More Information

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