Integrating Disease & Environmental Variables: The Case of Cryptosporidiosis & Dairy Farms in Massachusetts

Objective:

Using Massachusetts dairy farm locations and Cryptosporidiosis incidence as examples, this project demonstrates the application of GIS for the integration of environmental variables with incidence of disease. Each of these maps represents a variable which will be useful in future statistical analyses of environmental factors affecting incidence of Cryptosporidiosis.

Background:

Cryptosporidium is present in 60-97% of our surface waters. Many of us have been exposed to the two species affecting humans, either Cryptosporidium parvum (CP) or hominis (CH), at some point in our lifetime. The result is diarrhea and nausea, ranging from mild to severe. Although healthy people recover easily, Cryptosporidiosis is a life threatening disease for immunocompromised individuals and the elderly. Cryptosporidiosis incidence is vastly underreported throughout the United States, although it is accountable for the largest water supply contamination outbreak in U.S. history, in Milwaukee in 1993.

The Massachusetts Department of Public Health passive surveillance data for Cryptosporidiosis incidence from 1993-2003 does not classify by species. Therefore incidence in a town may reflect contamination by parvum (carried predominately by cattle) or by hominis (carried predominately by people).

Proximity of Dairy to Water Supply Intake

Cryptosporidiosis rates are highest on average in urban areas, possibly indicating presence of C. hominis (the species passed between humans). Two western Mass towns show high rates of Cryptosporidiosis.

Caveats:

Because water is a transboundary resource, waste from one town may affect another town or several towns downstream. This study does not include water flow variables or elevation, both of which could significantly change the potential for a town’s water supply to be impacted by a neighboring dairy farm. Positions of dairy farms were georeferenced to the Massachusetts State Outline using a scanned map. Therefore, a high potential for error exists when measuring distance between farms and other points, such as water variables.

The table above represents an example of how dairy farm attributes are integrated with incidence data.

<table>
<thead>
<tr>
<th>TOWN_ID</th>
<th>TOWN</th>
<th>POP2000</th>
<th>Dairy Farms</th>
<th>Number of Cattle</th>
<th>Farms w/in 1 mile of Public Water Supplies</th>
<th>Avg Distance to Rivers</th>
<th>COUNTY</th>
<th>LANDAREA of Town (sq miles)</th>
<th>POP DENSITY</th>
<th>Number of Crypto Cases</th>
<th>Rate of Crypto Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>COLRAIN</td>
<td>1813</td>
<td>6</td>
<td>6</td>
<td>272.19</td>
<td>F</td>
<td>43.38</td>
<td>41.80</td>
<td>6</td>
<td>41.80</td>
<td>1</td>
</tr>
<tr>
<td>67</td>
<td>CONCORD</td>
<td>16993</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
<td>M</td>
<td>24.02</td>
<td>682.00</td>
<td>9</td>
<td>5.30</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>CONWAY</td>
<td>1809</td>
<td>3</td>
<td>2</td>
<td>277.71</td>
<td>F</td>
<td>37.71</td>
<td>48.00</td>
<td>0</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>CUMMINGTON</td>
<td>978</td>
<td>3</td>
<td>600</td>
<td>18.66</td>
<td>HS</td>
<td>23.05</td>
<td>42.40</td>
<td>0</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

Cartographer: Allie Quady, May 2008
Tufts University Friedman School of Nutrition, MS/MPH
Map Projection: Massachusetts State Plane 1983
Resources: MassGIS
Massachusetts Department of Public Health
Centers For Disease Control