

GEOSPATIAL ANALYSIS OF WISCONSIN HONEY BEE HIVES

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Abstract

This research is a response to the outbreak of Colony Collapse Disorder (CCD) that hit the United States in 2005. We focus on the health of Wisconsin apiaries; with regard to differences in rural and urban environments. 61 beekeepers responded to a 48 question survey measuring qualitative and quantitative information. Survey data was then used in conjunction with Geographical Information Systems (GIS) and the North American Statistics Service (NASS) crop cover data to create maps used to determine how hive health might relate to crop cover. We looked at overall honey yield, honey yield per hive, overall losses, types of honey bees, infestations etc. Our research's use of geospatial technologies to assess the health consequences of hive locations sheds light on the human-environmental interactions and regional factors from which we draw our conclusions. This research focuses on the influence of apiary size and proximity to urban environments in relation to the overall health of honey bee hives in Wisconsin.

Research Question

My research focuses on the hobby beekeeper, hobby, defined as an activity undertaken for pleasure, whose sole income is not derived from beekeeping alone, the overall health of their apiaries and how hive health differs by location. What influence does apiary size or proximity to urban environments have on the overall health of honey bee hives in Wisconsin?

I want to know the geographical consequences of hive location; looking at geographical factors: human-environmental and regional to draw conclusions. Looking at the spatial patterns of environmental factors, hive losses, and human factors; size of the apiary and certain location of the hives are human factors. I intend to compare hive health per location based off these criteria

Using the overarching idea that success in beekeeping is based off two major concepts:

- Honey yield
- Low winter losses.

Methodology

Two approaches were used, a survey and geospatial technologies. The 48 question survey asked questions about the overall hive health and distribution measuring quantitative and qualitative data. The survey was made available online and sent to beekeepers, 61 responded to the survey.

The geospatial approach displayed the data collection to better understand the health and distribution of honeybees within the state of Wisconsin. The GIS database housed both quantitative and qualitative data gathered from the survey along with land cover/use data gathered primarily from remotely sensed imagery. Geospatial Technologies used include: GIS database created, land use/land cover and remotely sensed imagery.

Limitations

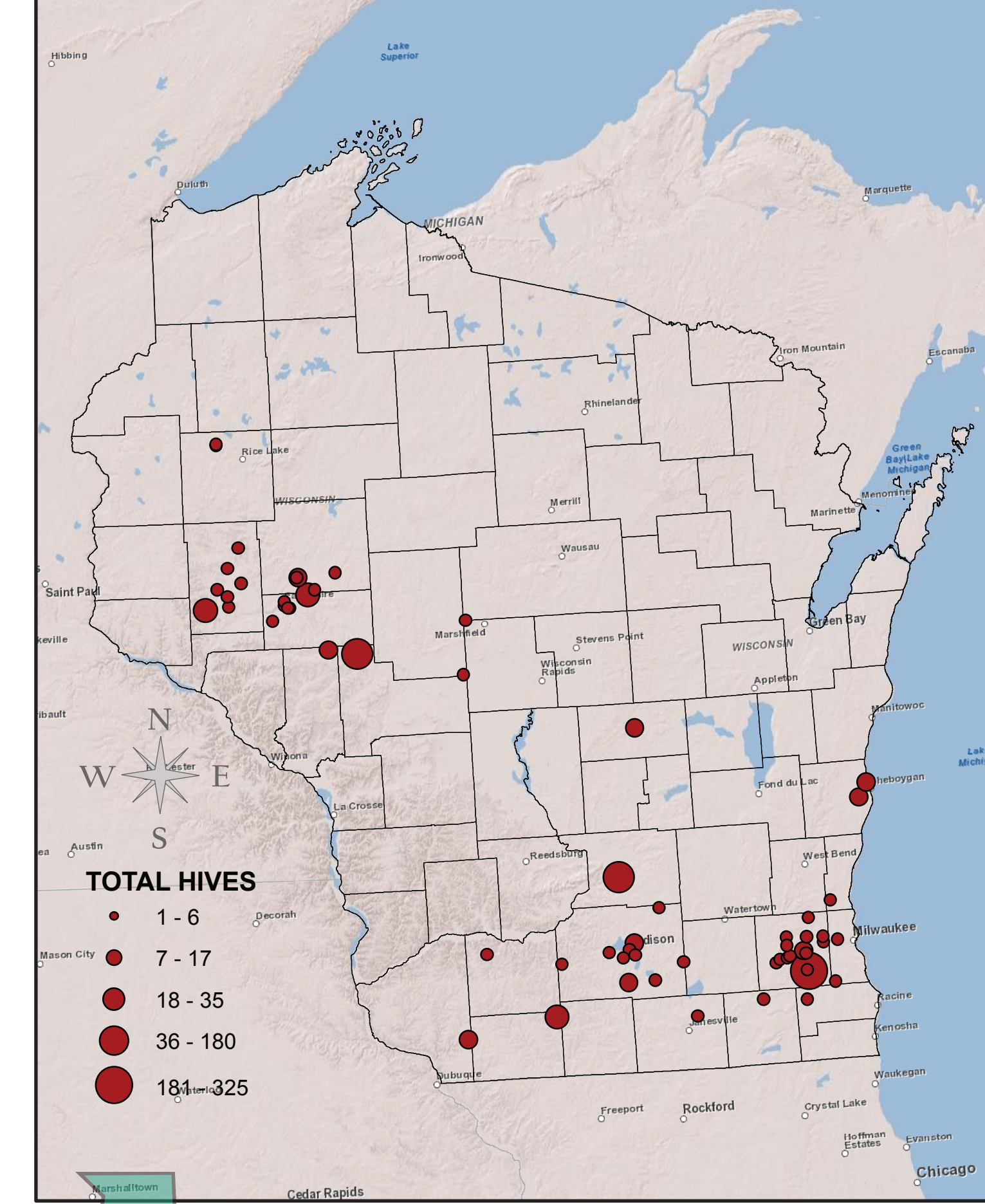
The survey was sent out to 150 beekeepers, 61 responded. The survey was dispensed over a month and a half in the summer of 2012 through contacts found in the 2012 Western Wisconsin Farm Fresh Atlas 2011 and 2012, Beekeeper Associations and contacts found via honey jars from surrounding grocery stores in the Chippewa Valley of Wisconsin. In addition to these contacts, I cold called orchard owners asking who pollinates their fruit trees in attempts to reach more beekeepers.

There are, no doubt, uncontrollable factors such as the scope of my project; I was unable to reach certain beekeepers that fall out of the scope of beekeeper associations and those not accessible to the internet where my survey was housed. Based solely off my findings, there appears to be no hives in Northern Wisconsin or along the Driftless region (the South Western portion of the state) but this is not true. Lack of internet usage knowledge and lack of whereabouts of various beekeepers in Wisconsin resulted in the ability of respondents to my research survey.

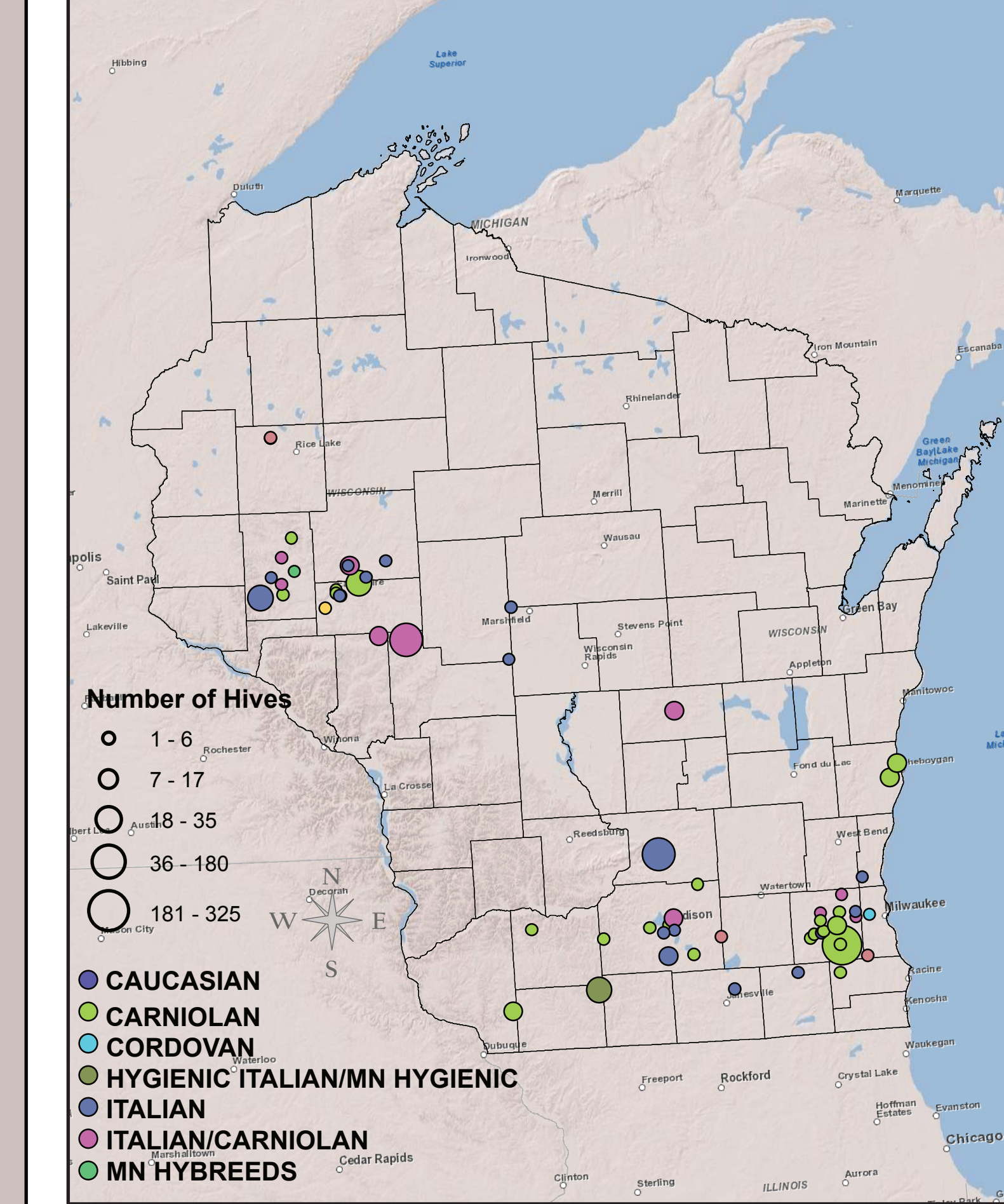
Findings

My extrapolations of the data include: honey yield per location, total hive count per location, varieties of honey bees per location, hive pest problems and overwinter losses, dead queen, swarming. Beekeepers who responded to the survey are located in West central and South Eastern Wisconsin. The maps show the variations between various apiaries ranging from a single hive in an apiary to 325 hives in an apiary. Larger apiaries are located in rural settings whereas generally smaller apiaries are located in urban settings. Apiaries vary in size; production level of honey is similar by size of the apiary. But individual hive yield is higher in urbanized areas versus rural areas.

Total Hive Count per Location



Varieties of Honey Bees per Location



Conclusions

Lack of food sources for the honey bee population result in lower honey yields, the maps above demonstrate the relationship between hive location and certain types of land use. Based off the survey results, urban areas have higher honey yields as compared to rural areas. There are two outliers in the data; the apiaries just out of town in Cumberland and Platteville have extremely high yields for being located in a rural setting. After conversing on the phone with the beekeepers of these two areas, I asked them to describe their general location. They both reported on the incredible amount of diversity and foraging opportunities for the honey bees.

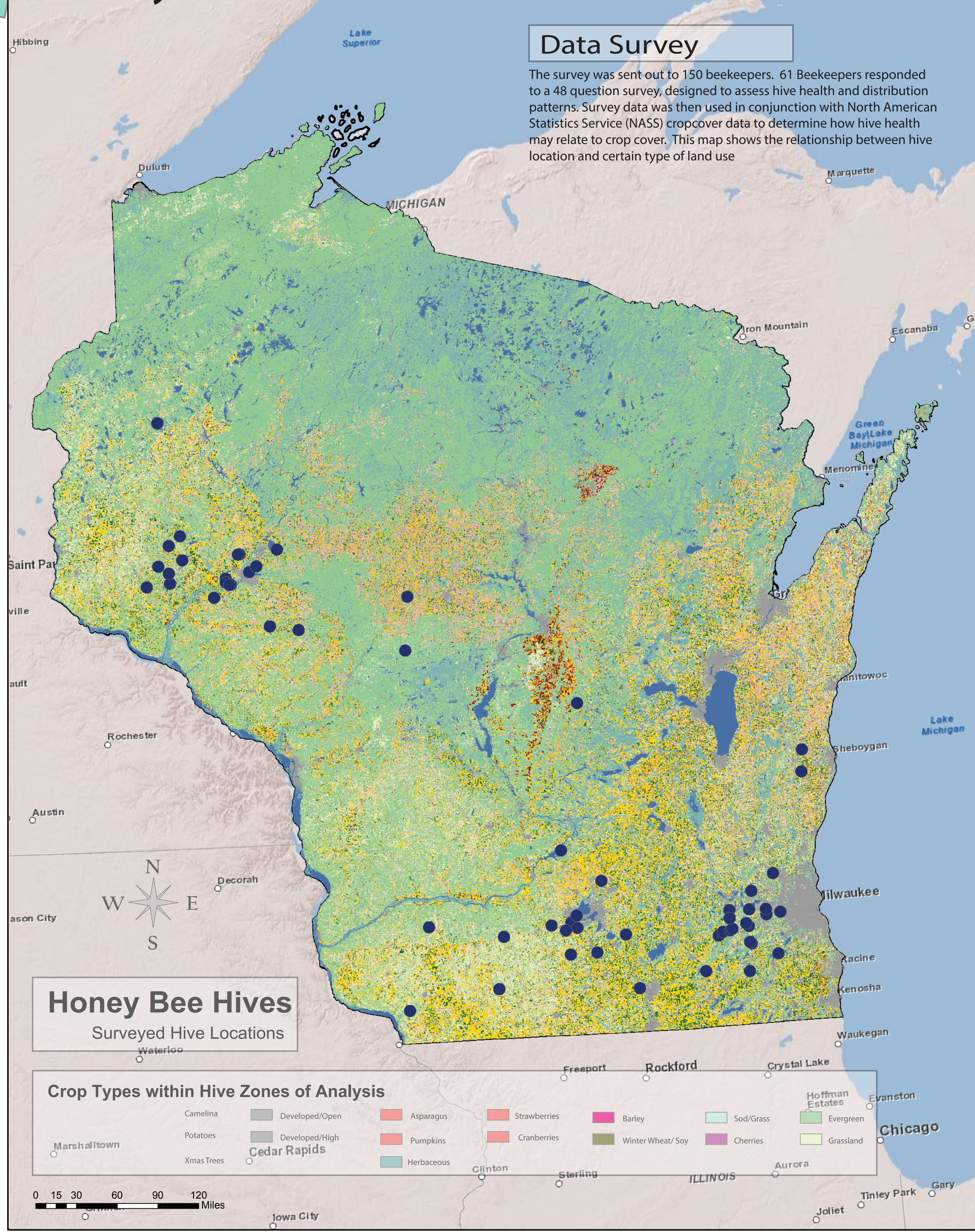
Schacker (2008) describes how beekeepers in France began a program to locate hive atop of buildings in urban areas, and quickly realized that city bees did better and made more honey than their country cousins. Apparently, warmer temperatures in the towns and cities allowed the bees to be active for longer periods and gather more nectar and pollen, which was readily available to parks, lawns, gardens, and flower boxes, which are usually not sprayed with chemicals.

The Ratio of total hive count per location and total honey yield per location in gallons demonstrates similar results to what Schacker describes about urban French beekeeping. The overall hive losses maps shows the overall hive losses for 2011. Although hive losses are normal, reducing the percentage of losses is strived for, the exact reason for the declining numbers of hive losses are unknown. But the National Research Council's 2007 report may have the answer: The Status of Pollinators in North America reports a 'Pollinator Crisis' due to a systematic decrease in the overall pollinator population size over time. Honey bees are not the only pollinator in trouble, there has been a 40% decline in butterfly diversity, and 2/3rd's of the pollen-feeding bats in the United States are endangered. Not to mention a severe decline in the pollinator's specialized flowers are disappearing as well.

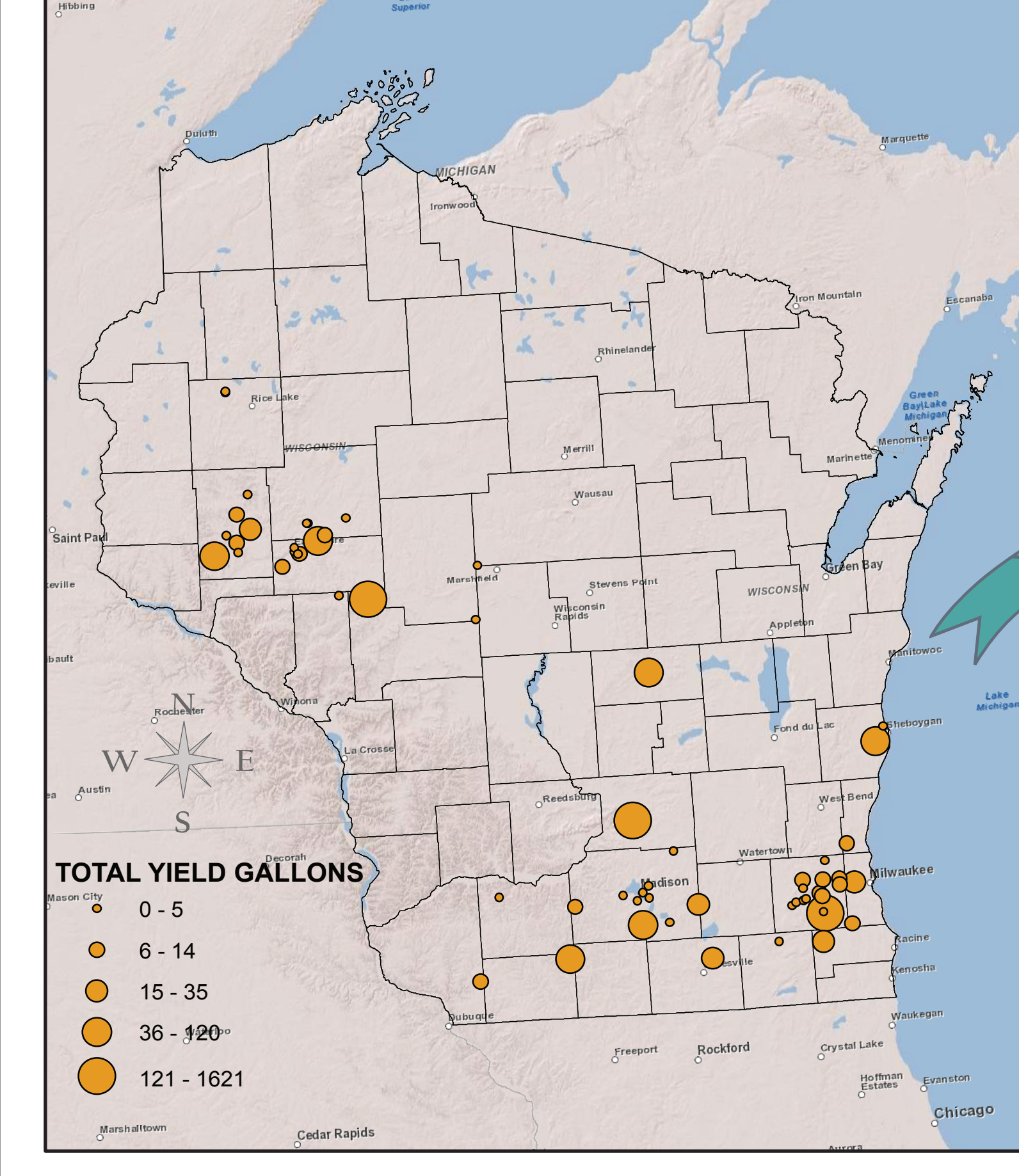
Honey Bee Hive Locations in Wisconsin

Data Survey

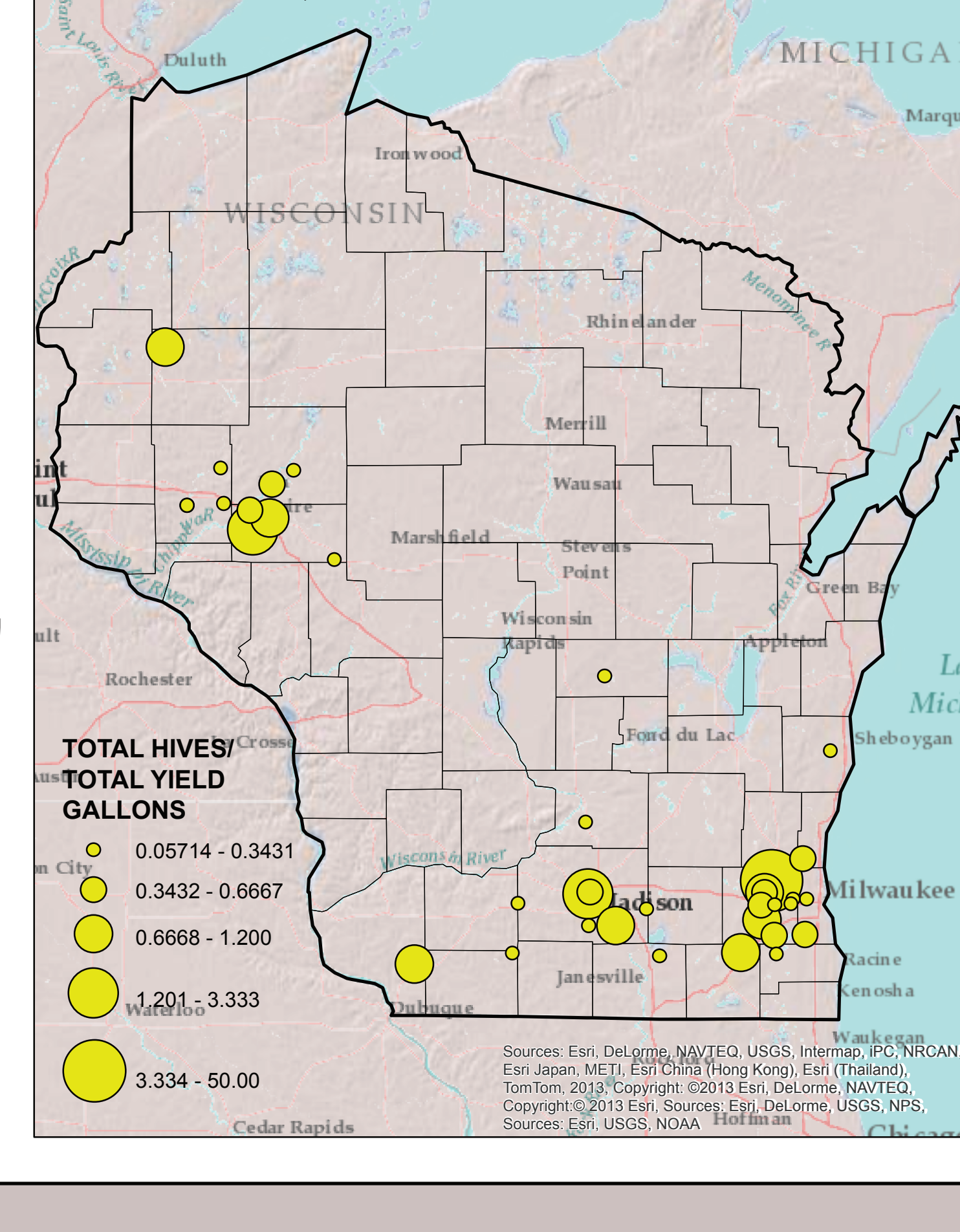
The survey was sent out to 150 beekeepers. 61 Beekeepers responded to a 48 question survey, designed to assess hive health and distribution patterns. Survey data was then used in conjunction with North American Statistics Service (NASS) crop cover data to determine how hive health may relate to crop cover. This map shows the relationship between hive location and certain type of land use



Total Honey Yield per Location In Gallons



Ratio of Total Hive Count per Location and Total Honey Yield per Location in Gallons



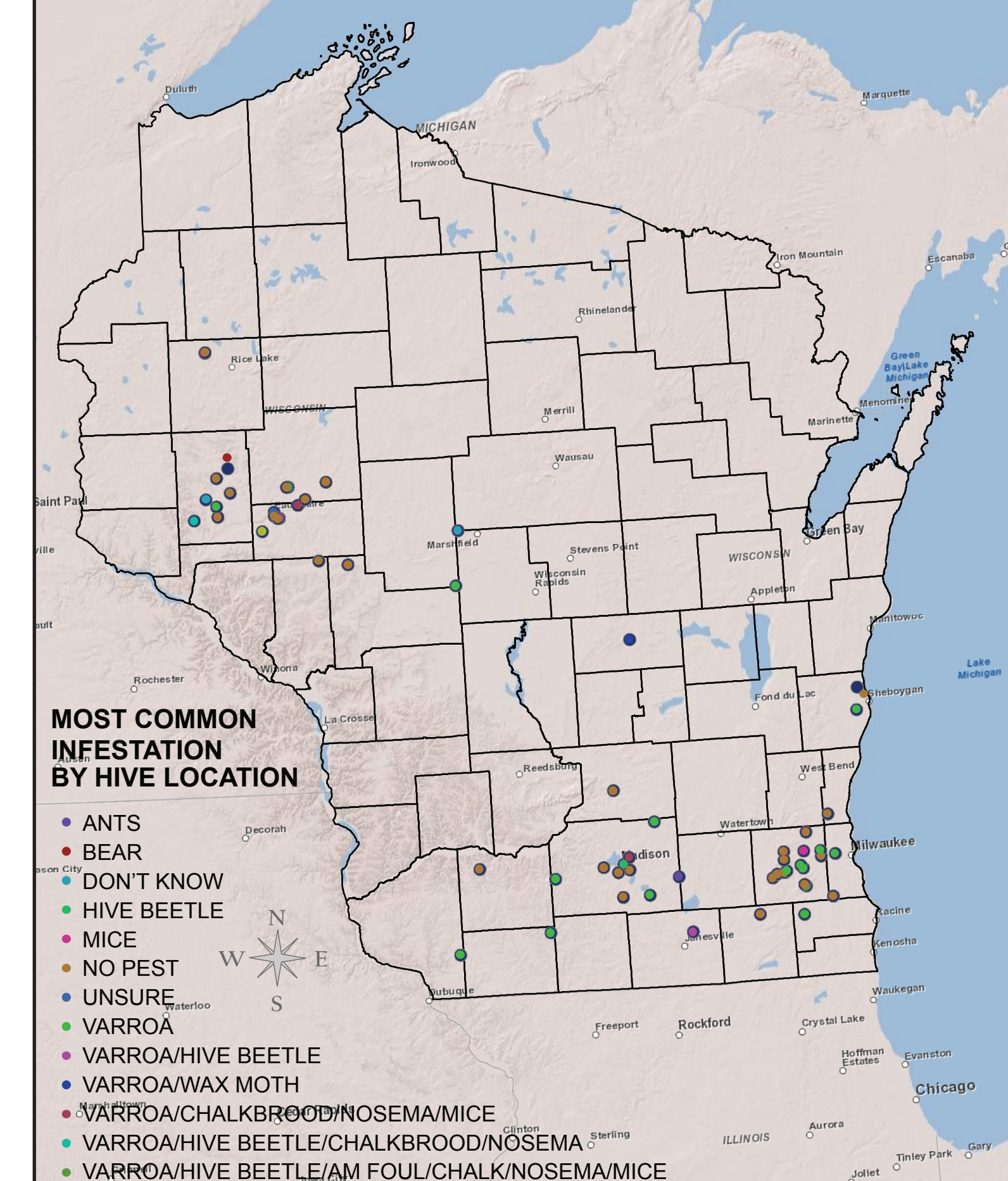
Future Research

Building healthy, thriving habitats for honey bees by planting native and perennial wild flowers that grow naturally will create natural bee habitats. Local flowers are adapted to the local climate producing more nectar and pollen for the honey bee population. Diverse floral island as described as a pollinator paradise that helps restore nature's balance that has been depleted due to monocultures and lack of diversity is apparent in the lack of surviving honey bee hives post winter.

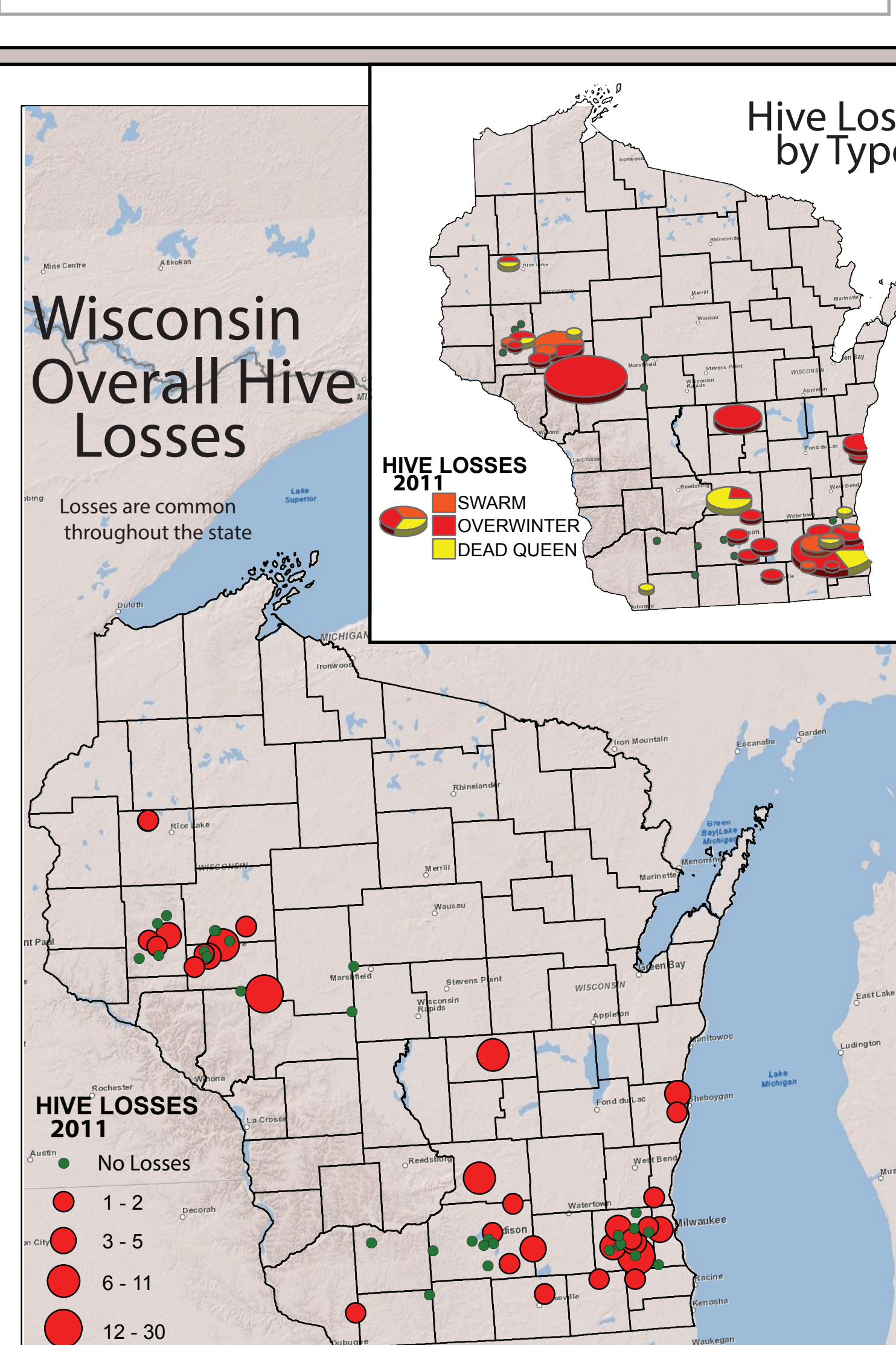
Success in Beekeeping is based on two factors: Honey yield and Low winter losses. Resulted in higher honey yields in urban environments and fewer over winter losses, interestingly enough, swarming only occurs around urban environments. Based off my survey results I was able to correlate smaller apiary sizes in urban environments to high honey yields and lower over winter losses. Based on results, urban beekeeping produces higher yields of honey. Many questions are unanswered, many new questions are raised.

Future research seeks to correlate land cover, land use, and agricultural practices to overall honey bee health. Dr. Joe Hupy and I are currently developing geo-statistical methods to determine if honey bee losses are indeed anthropogenically induced. Currently over-winter loss is not related to land cover, crop type, or pesticide use for that matter. Future maps products, however, will demonstrate if these relationships do occur, thereby providing geospatial insight what types of environments our leading agricultural pollinator (the honey bee) will prosper. Current research findings suggest insecticides and monoculture crops may be related to the decline of the honey bee population at an exponential rate since 2006. Much of this research, however, takes a non-spatial approach. Continuing geospatial research on the causes of the decline of the honey bee population would better understand ideal honey bee habitat and show where more honey bees could be placed for better pollination patterns before the decline has drastic economic implications for the US. Agricultural system.

Common Honey Bee Hive Pest Problems



Overall Hive Losses in 2011



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