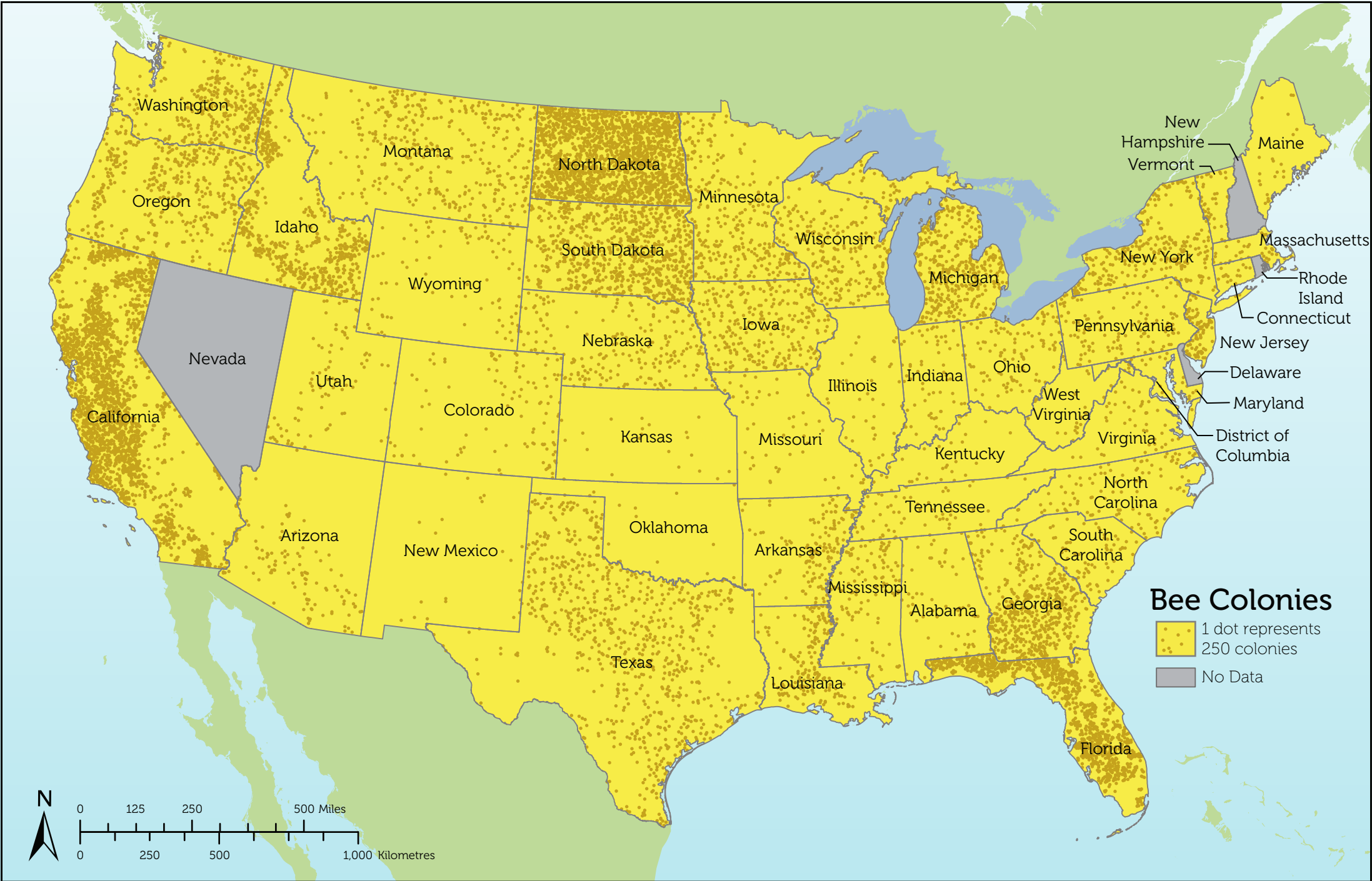


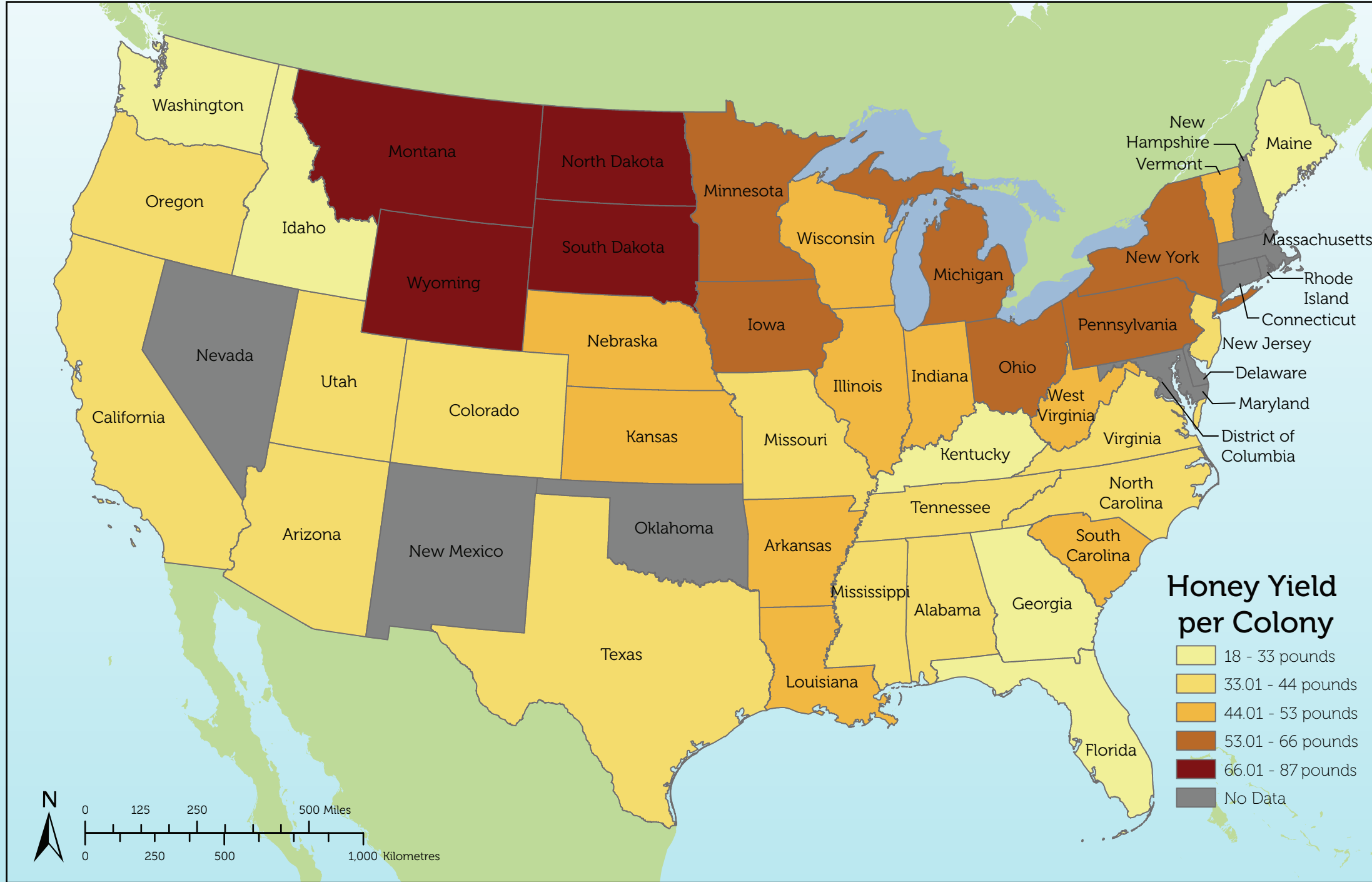
BEE COLONY HEALTH AND HONEY PRODUCTION IN THE UNITED STATES

MAXIMUM COLONIES – JUL TO SEP 2023



This dot density map displays the maximum number of bee colonies in each state of the United States between the months of July to September. This defined as the number of colonies existing on July 1st, plus any additional colonies that were created or moved into the state over this time period. This time period was used as it was the most recent data encompassing the months where honey is commonly harvested. Dot density maps are an easy to understand way of displaying the raw counts of data present in each enumeration area of a map. Every dot on the map represents a specific number of instances of the counted data — in this case, bee colonies. Displaying that data like this clearly communicates the frequency of occurrences of the phenomenon in a given area compared to the others, as dots become closer together where it is more common. For this reason, dot density maps should be displayed with an equal area projection so that the visual density remains true to the data. While this map type gives a good sense of the data counts, an accurate count is usually impossible to estimate due to the frequency of the dots. Additionally, the randomness of the dot positions can give a false sense of the location of the information being displayed, especially if the dots would more accurately be clustered in a small portion of your enumeration unit. For this reason, it is ideal to create the dot density map using data separated by smaller units than you plan to show, and then layer those dots over the intended enumeration units. Then, your dots will cluster more accurately to their true locations. This data was not broken down into any units more specific than states, and such data was not publicly available. Instead, I found some satellite data that identified all of croplands in the United States, and assuming that this would also be where bees are kept, geoprocessed that data until I could use it as a constraint for the placement of the dots. By limiting them to cropland, the map now displays a more accurate sense of where human-kept bee colonies are found.

HONEY PRODUCTION – 2023



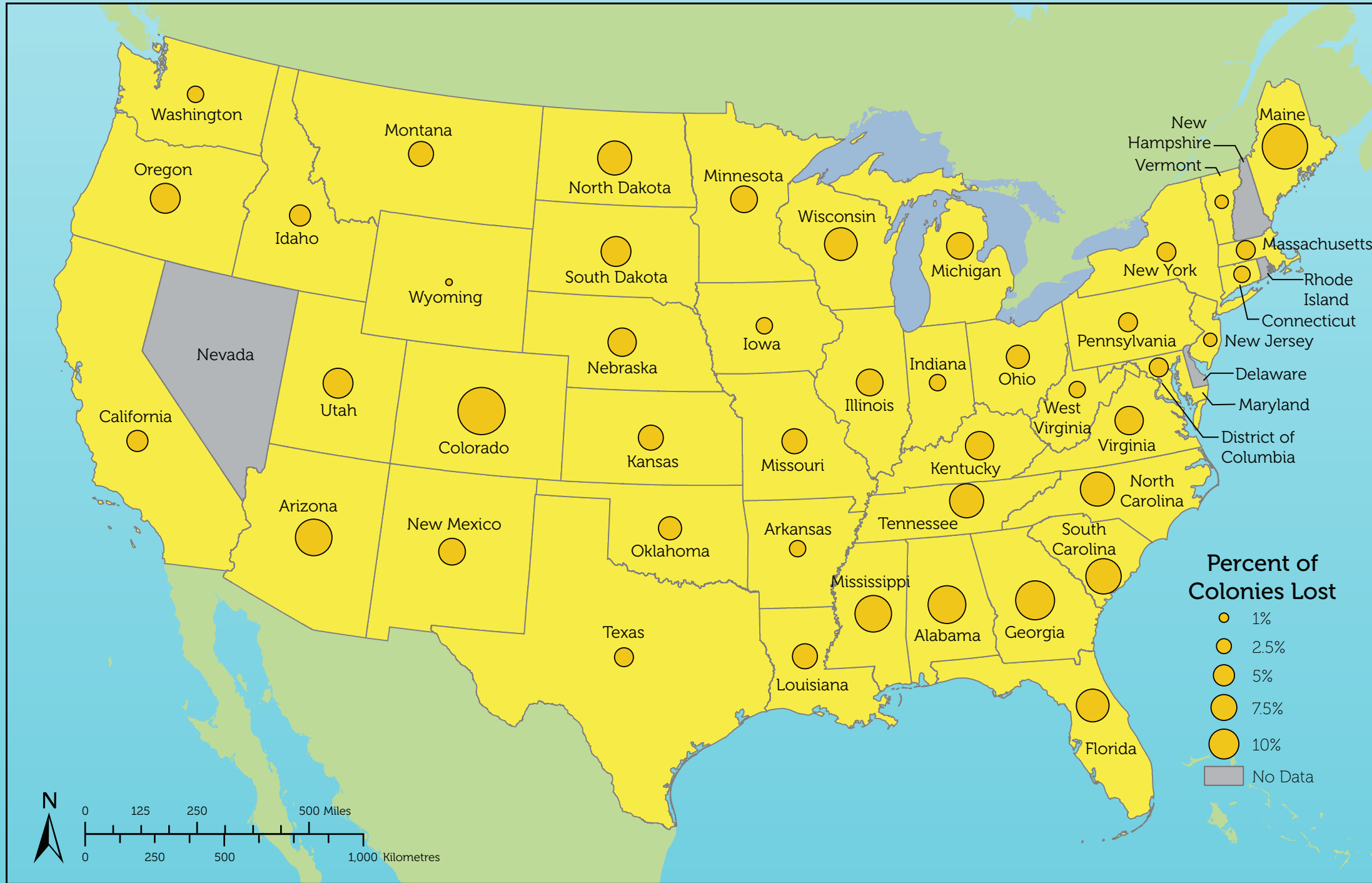
This classed choropleth map shows the average amount of honey produced per colony in 2023 in the United States, separated by state. These maps are used to break data down into a number of classes and symbolize that information in a way that visually ties that data to the area it represents. Choropleth maps require quantitative data that has been collected by enumeration unit — ideally originally collected as a raw count. However, the raw counts can not be directly visualized as a choropleth map. They must be first generalized into a derived value that account for variations in the sizes of the enumeration units. Doing so mean that the data from areas of significantly different size can be accurately compared. On this map, instead of displaying the total amount of honey produced in each state, that data has been standardized by the number of colonies in each state to account for the varying number of bee colonies across the United States. Because of this standardization, choropleth maps should be mapped with an equal area projection so that the differences in size of these enumeration areas is still communicated. This standardization does come with the downside that choropleth maps suggest the studied phenomenon is equally distributed throughout the enumeration area. For example, on this map it's possible that the northern part of a state has significantly more productive colonies than the southern parts, and this choice of enumeration unit can not display that. It is also important to colour the different classes by a shaded gradient so that the change in value between classes is naturally understood by the viewer. While the hue does change between classes on this map for aesthetic appeal, the classes with higher yield are darker than the ones with less. There are also more states with no data on this map than the other maps. That is because states with a very low number of colonies were not included in this data set, but were included in the data set that was used for the other maps.

COLONIES STRESSED BY VARROA MITES – JUL TO SEP 2023



This graduated symbols map shows the percentage of colonies kept by operations with five or more colonies in the United States that were stressed by varroa mites between July to Sep 2023. Varroa mites are a parasite that lives on bees and their larva and can result in the death of a colony within a few years if left unchecked. A graduated symbols map divides the data set into a number of classes, representing each class with a symbol that is proportionally sized in relation to the smallest symbol. These proportional symbols quickly show the difference in magnitudes between values, and are best used when the magnitude differences are meaningful. This type of map requires quantitative data that can be aggregated within the desired enumeration unit, but as the symbols are drawn over enumeration units and are not semantically connected to their unit's size or shape, this style of map should not use data that has been normalized by area. It also can not use data that contains negative values, as drawing a shape with negative area is not usually possible. Any shape can be used to symbolize the data, from simple geometric shapes to three-dimensional models, but the basic circle as used on this map is often preferred as it is the easiest shape to quickly compare areas of. The difficulty in eyeballing the difference between areas is also why this type of chart is not suitable for data that only has a small range of values — identifying the differences between icons quickly becomes too difficult to expect your viewer to do.

COLONIES LOST – JUL TO SEP 2023



This proportional symbols map shows the number of bee colonies lost in each state of the United States between July and September 2023 as a percentage of the maximum number of colonies each state had during that time period. This is equal to the number of colonies lost divided by the maximum number of colonies. Like a graduated symbols map, the proportional symbols map is a way of displaying the magnitude of some subject data present in each enumeration unit. However, instead of breaking the data into classes, every symbol is drawn as a unique size, with area proportional to that of the smallest symbol. This method requires quantitative data aggregated within the enumeration units to be displayed, but can not display negative data as the concept of a negative area is difficult to draw. It can display negative data if all data is negative by redefining the quantity such that it is positive, but it won't work if numbers on both sides of zero exist. That is why this map can not display the change in colony numbers over these three months, as some beekeepers added enough new colonies that the overall numbers increased over the time period, while in other states the total number of colonies decreased. Also like a graduated symbols map, any shape can be used to visualize the data but circles are easiest to read, and they will be easier to read if the variation in magnitude between values is large. This is why the honey production map could not be symbolized using graduated symbols. While a larger symbol representing more production is very intuitive, the largest value is only five times the smallest and most values are less than three times, meaning all of the circles on such a map would look very similar to each other.



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