

# URBANIZATION AND BEE POPULATIONS

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## Background

Honeybees are the most popular type of pollinating insect in the world, making them one of the most used and effective pollinator species on Earth, by humans. They are responsible for pollinating roughly 80% of the food we eat, including up to 90 different species of food crops; valuing 215 billion US dollars (Smith et al., (2013). As the global population gets larger, humans begin to encroach more into honeybee habitat, forcing them to live among us. Furthermore, the increasing amount of impervious surfaces in urban areas is likely to further decrease bee populations, due to their habitat being taken away (Geslin et al., 2016). Without bees and other insect pollinators life as we know it would be altered, seeing that they play a key role in plant reproduction.

## Key Issue

As we continue to urbanize and grow our cities, pollinator habitat gets taken away, and we pollute the surrounding environment. Raising the question, "How does urbanization affect bee population?"

## Motivation

- Pollinators are essential for our everyday lives; from the food we eat to the little things like flowers that we enjoy. Seeing that proportion of crops that are dependent on pollination rose by 300% since 1961 (Smith et al., 2013). Humans are increasingly moving to more urban environments, as seen in Table 3. As we expand our reach on the natural environment, we're seeing bee populations decline. In other words, as the Anthropocene continues to alter and disturb the environment, the bees lose a significant amount of habitat (Wilson et al., 2019). As seen in table 2, beekeepers are seeing annual losses, without explanation, the same could be happening in more urban areas.
- Furthermore, as urban gardening gets more popular, so do the use of pesticides to maintain those gardens and nearby farms. One of which are neonicotinoids, which bind to nicotinic acetylcholine receptors, disrupting neurotransmitters eventually leading to paralysis and death (Abbo et al., 2017; Hopwood et al., 2016). With increased use of this pesticide, incorrect application could lead to it drifting in unwanted areas, further affecting local bee and other insect pollinators.
- We propose to evaluate the effects of urbanization on bee populations, through changes in habitat and pollutants.

## Our Hypothesis

Urbanization negatively affect bee populations, because of the lack of habitat and increase pollutants. Based on this reasoning we predict that urbanization will have a negative effect on bee populations.

## Predictions

- We predict that we will see a decline in bee population, at the end of the collection period, due to effects from urbanization. As seen in Table 1, we're expecting for the number of bees to fall during the second count.

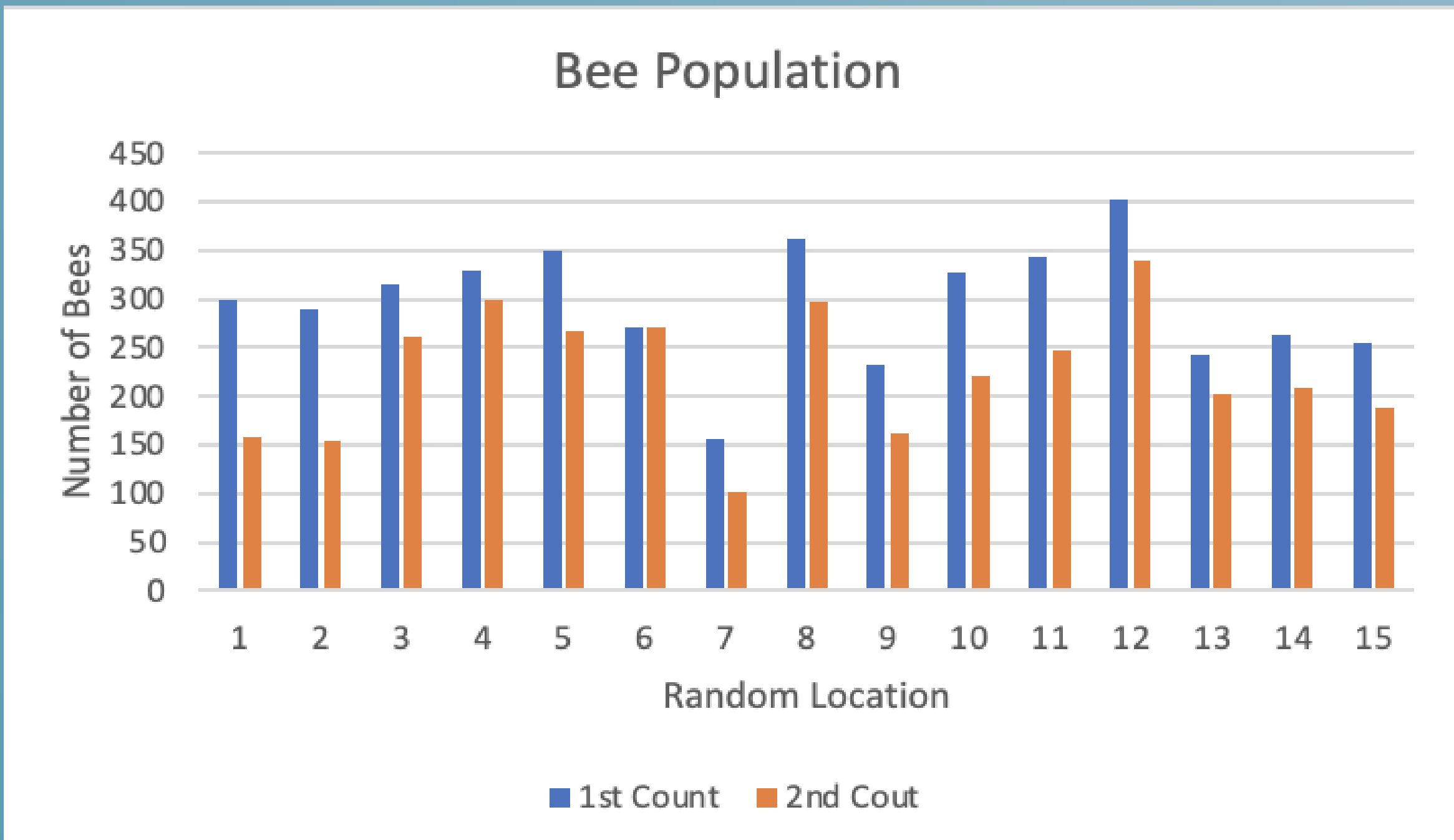


Table 1. Our predicted analysis of our study

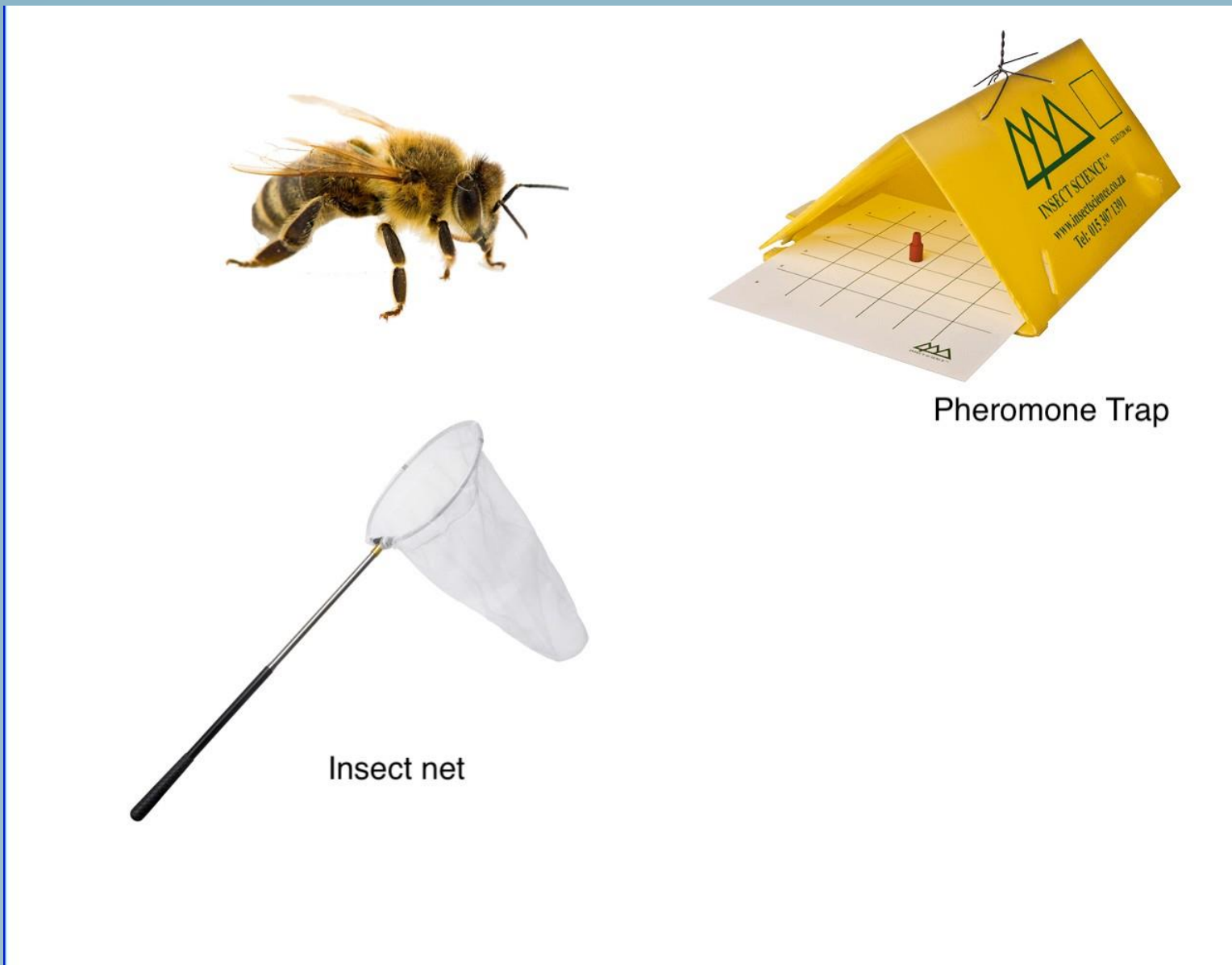


Figure 1: Capture Methods

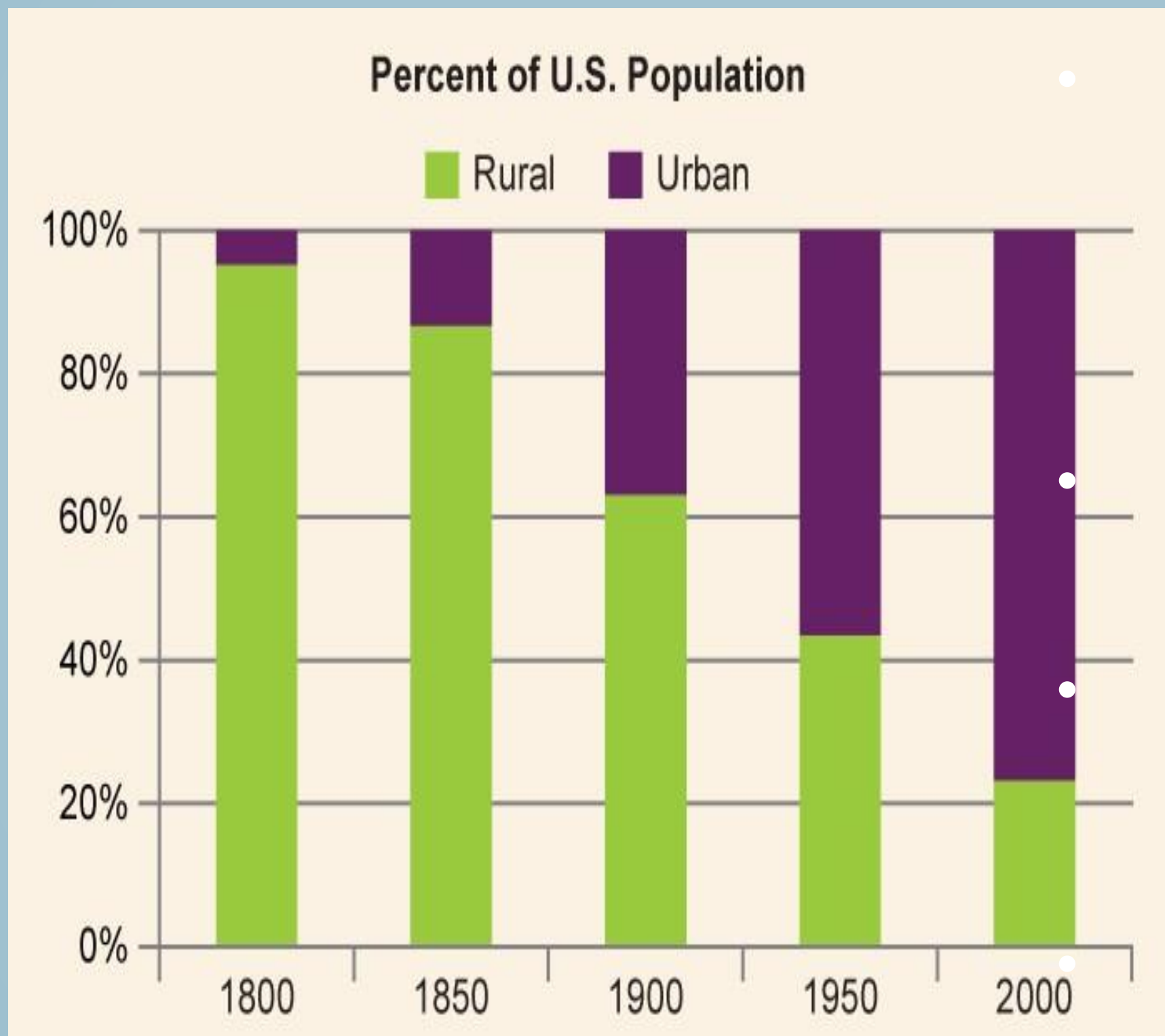


Table 3. Rise of urbanization in the US (Lumen, n.d)

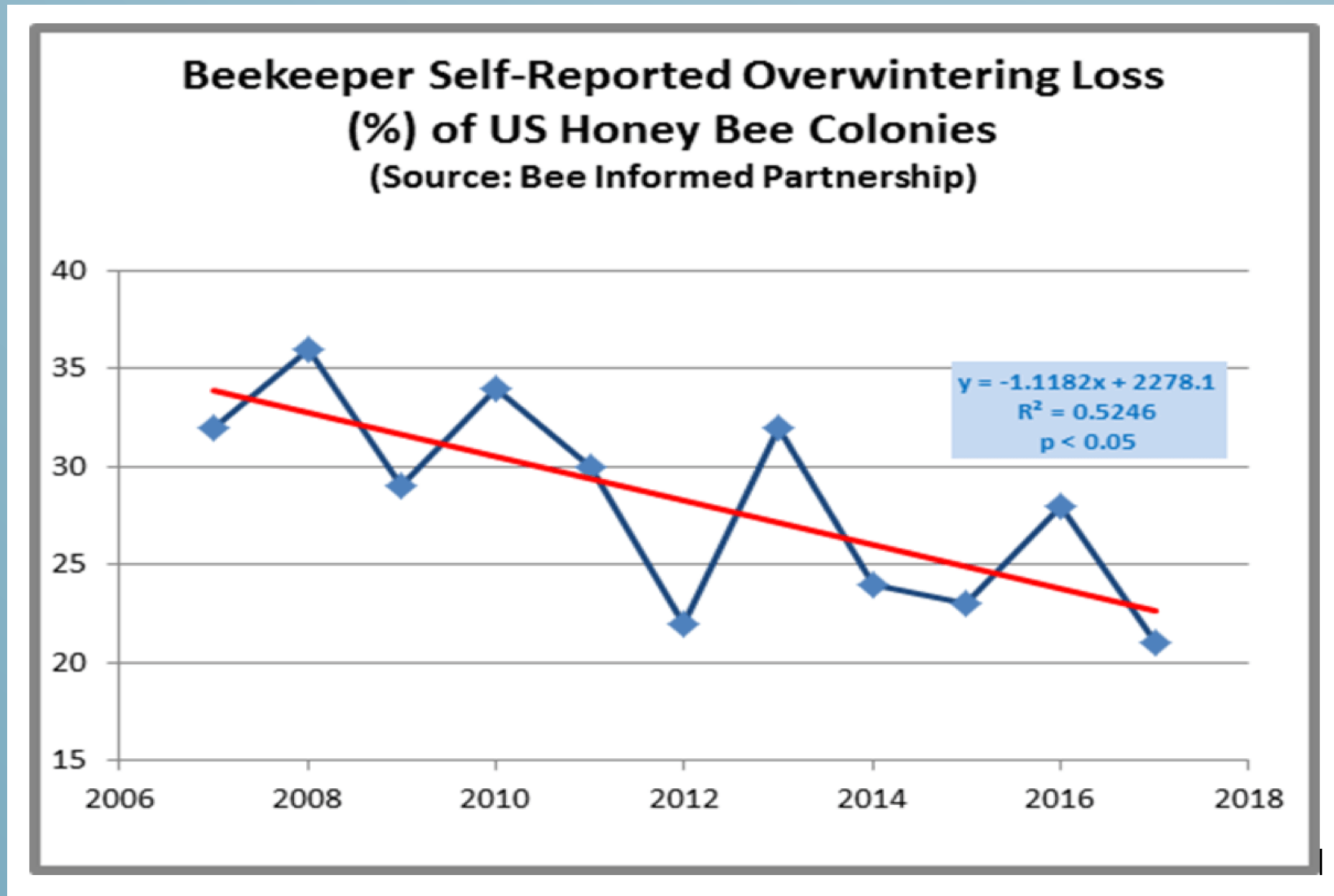


Table 2. Over wintered bee population (Entine, 2020)

## Study Design

- Our study will take a closer look at the relationship between honeybees and their environment. This is to investigate the effects of urbanization on honeybee populations. The study will be an observational study consisting of 15 randomly selected locations, and we will count the number of bees in each location twice. First count in June and the second in August.
- The study will follow the number of bees collected in varying amounts of urbanized environments (urbanized environments will be classified with the proportion of impervious surfaces), compared to their population numbers 3 months later.
- We will collect samples via trapping, using the pheromone traps and hand netting as seen in figure 1. The number of individuals will be recorded by two different people, to ensure accurate numbers.

## Intended Analysis

- By conducting a double count of the bee populations from the 15 random locations, we can see how the surrounding environment will affect their populations. Based on our hypothesis, our inference is that the populations will decrease. This type of observational study will allow us to include key aspects of the experimental design process including randomization (other randomly selected locations) to ensure the data is not biased and replication (multiple counts per location) (Steber, 2021).
- -The variables we will account for are, the number of bees collected at each location as the response variable. And the levels of urbanization, measured by the proportion of impervious surfaces, as the predictor variable.
- - This will allow our experiment to have a much broader scope that we can then generalize to larger plots of land, and more locations worldwide to get a full understanding of the affects that urbanization has on bees on a larger scale and determine the reason for reducing numbers.
- - If were able to conduct this study expected results could be seen through a regression line. This can be used to see the correlation between rising urbanization and declining bee numbers; as urbanization increases, bee populations fall.
- Management implications will include the following... observational studies are limited; replication can be skewed because we are observing natural organisms that are unpredictable. In terms of study design, we may run into issues involved in traveling to 15 different locations to perform a population count, this can be an expensive and time-consuming process (Hess A.S et al., 2019). Also, more urbanized locations can have a larger impact on generalized analysis, this is a price we must pay for selecting random locations.

## Expected Benefits

If a correlation is found, this data could be beneficial in determining best practices for sustainability when developing urban areas in the future, seeing that by 2050 it is expected that 67% of the worlds population will reside in a city (Hall et al., 2017). That said, research done previously on wild and solitary or exotic bee population show that cityscapes can be beneficial to their populations, by keeping their food source close, and providing some form of "safer" habitat (Hall et al., 2017; Wilson et al., 2019). However more research needs to be done on this matter.

### Works Cited

• Abbo, P. M., Kawasaki, J. K., Hamilton, M., Cook, S. C., DeGrandi-Hoffman, G., Li, W. F., Liu, J., & Chen, Y. P. (2017). Effects of Imidacloprid and Varroa destructor on survival and health of European honey bees, *Apis mellifera*. *Insect Science*, 24(3), 467–477. <https://doi.org/https://doi.org/10.1111/744-7917.12335>

• Hopwood, J., Code, A., Biddinger, D., Shepherd, M., Hoffman Black, S., Lee-Mader, E., & Mazzacano, C. (2016). How Neonicotinoids Can Kill Bees (2nd edition, Revised and Edited). [https://xerces.org/sites/default/files/2018-05/16-022\\_01\\_XercesSoc\\_HowNeonicotinoids-Can-Kill-Bees\\_web.pdf](https://xerces.org/sites/default/files/2018-05/16-022_01_XercesSoc_HowNeonicotinoids-Can-Kill-Bees_web.pdf)

• Hall, D.M., Camilo, G.R., Tonietto, R.K., Ollerton, J., Ahrné, K., Arduser, M., Ascher, J.S., Baldock, K.C.R., Fowler, R., Frankie, G., Goulson, D., Gunnarsson, B., Hanley, M.E., Jackson, J.I., Langellotto, G., Lowenstein, D., Minor, E.S., Philpott, S.M., Potts, S.G., Sirghi, M.H., Spevak, E.M., Stone, G.N. and Threlfall, C.G. (2017). The city as a refuge for insect pollinators. *Conservation Biology*, 31: 24–29. <https://doi.org/10.1111/cobi.12840>

• Smith, K.M., Loh, E.H., Rostal, M.K. et al. Pathogens, Pests, and Economics: Drivers of Honey Bee Colony Declines and Losses. *EcoHealth* 10, 434–445 (2013). <https://doi.org.ezproxy.uvm.edu/10.1007/s10393-013-0870-2>

• Wilson, C. J., & Jamieson, M. A. (2019). The effects of urbanization on bee communities depends on floral resource availability and bee functional traits. *PLoS one*, 14(12), e0225852. <https://doi.org/10.1371/journal.pone.0225852>

• Hess A.S., Abd-Elseyed A. (2019) Observational Studies: Uses and Limitations. In: Abd-Elseyed A. (eds) Pain. Springer, Cham. [https://doi.org/10.1007/978-3-319-99124-5\\_31](https://doi.org/10.1007/978-3-319-99124-5_31)

• Steber, C. (2021). Observational research: Data collection advantages and disadvantages. Retrieved May 2, 2021

• Entine, J. (2020, March 20). Genetic Literacy Project . No, We Aren't Losing All of Our Honeybees. And Neonicotinoid Seed Coatings Aren't Driving Their Health Problems—Here's Why; Genetic Literacy Project. <https://geneticliteracyproject.org/2020/03/20/no-we-arent-losing-all-of-our-honeybees-and-neonic-seed-coatings-arent-driving-their-health-problems-heres-why/>

202 <https://www.cfrinc.net/cfrblog/observational-research-advantages-and-disadvantage>

• Lumen Learning. (n.d.). Sociology.