

United States Honey Bee Colony Losses 2020-2021: Preliminary Results
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Note: This is a preliminary analysis. Sample sizes and estimates are likely to change. A more detailed final report is being prepared for publication in a peer-reviewed journal at a later date.

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The Bee Informed Partnership (<http://beeinformed.org>) is a non-profit organization that works alongside beekeepers to improve honey bee colony health and survivorship across the United States. One of the organization's longest running programs, the National Colony Loss and Management Survey was initiated with the support of the Apiary Inspectors of America in 2007. Since then, it has monitored managed honey bee colony loss rates, and identified risk factors and protective measures associated with beekeeping management (Steinhauer, vanEngelsdorp and Saegerman, 2021).

This year marks the fifteenth anniversary of the survey, which relies on voluntary participation of beekeepers across the country during the month of April. It covered the one year period between April 2020 and April 2021.

A total of 3,347 beekeepers from the United States that collectively managed 192,384 colonies on 1 October 2020 provided validated survey responses. This represented 7% of the estimated 2.71 million managed honey-producing colonies in the country in 2020 (USDA NASS, 2021).

Colony loss rates were calculated as the ratio of the number of colonies lost to the number of colonies managed over a defined period (Kulhanek *et al.*, 2017). Loss rates should not be interpreted as a change in population size because beekeepers are able to replace lost colonies throughout the year. Therefore, colony loss rates are best interpreted as a turn-over rate, as high levels of losses do not necessarily result in a decrease in the total number of colonies managed in the United States.

During Winter 2020-2021 (1 October 2020 – 1 April 2021), an estimated 32.2% of managed colonies in the United States were lost (Fig. 1). This represented an increase of 9.6 percentage points (pp) over the previous winter loss rate (22.6%), and was 3.9 pp higher than the average

winter loss (28.3%) reported by beekeepers over the previous 14 years. Every year, participants were asked to report what level of winter loss they would consider acceptable. This year respondents reported that a 23.3% winter loss would be acceptable, which is 2.3 pp higher than last year (21.0%) and 5.6 pp higher than the average of 17.8% over previous years.

During Summer 2020 (1 April 2020 – 1 October 2020), an estimated 31.1% of managed colonies were lost in the United States (Fig. 1). This was slightly lower – 0.9 pp – than last year’s estimated summer colony loss (32.1%), but it was 8.6 pp higher than the average summer loss reported by beekeepers since the summer of 2010 (22.8%), when summer losses were first monitored.

Over the entire year (1 April 2020 – 1 April 2021), beekeepers in the United States lost an estimated 45.5% of their managed honey bee colonies (Fig. 1). This is the second highest annual loss on record, 1.8 pp higher than last year’s estimated annual loss (43.7%), and a 6.1 pp increase over the average loss rate (39.4%) over the last 10 years.

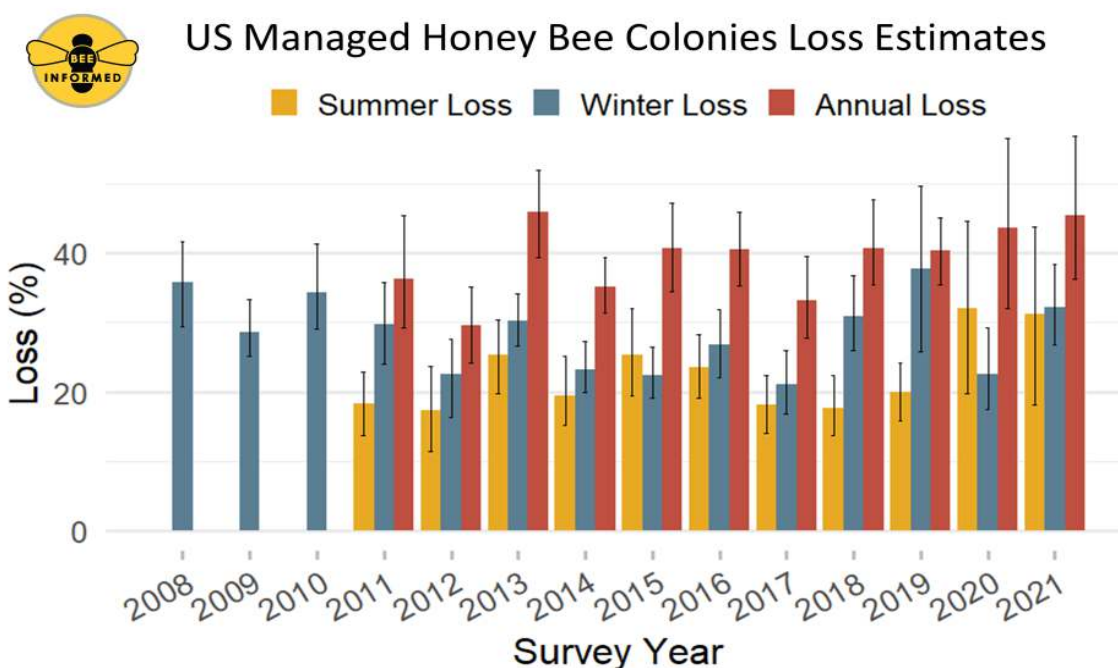


Figure 1: Seasonal honey bee colony loss rates in the United States across years. Annual loss estimates (from one 1 April to the next 1 April) combine winter (1 October – 1 April) and summer (1 April – 1 October) losses. The loss rate was calculated as the total number of colonies lost divided by the number of colonies “at risk” during the season. Colonies at risk were composed of viable colonies and new colonies made or acquired, while excluding colonies sold or parted with.

The honey bee industry in the United States is loosely divided into three groups of beekeepers: backyard (managing fewer than 50 colonies), sideliner (managing 51-500), and commercial (managing 501 or more colonies). As reported in previous years, backyard and sideliner beekeepers experienced a lower rate of loss during the summer when compared to the succeeding winter (27.0% vs 42.0% for backyard, and 19.5% vs 31.9% for sideliners). In contrast, commercial beekeepers, as they have reported in previous years, experienced loss rates that were similar in summer and winter (30.9% vs 32.9%; Fig. 2).

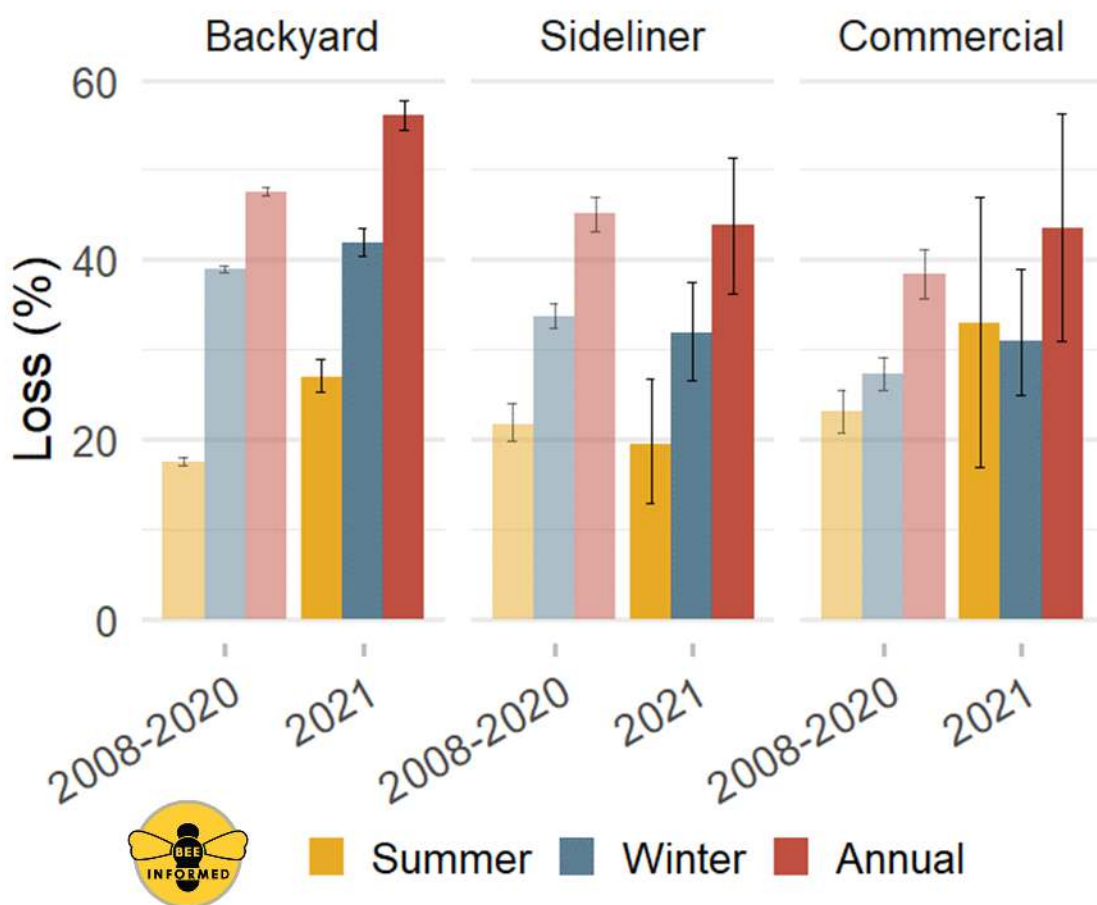


Figure 2: Managed honey bee colony loss rates estimated from different beekeeper operation types in the United States during the survey periods - summer (1 April – 1 October), winter (1 October – 1 April) and annual (1 April – 1 April). The average loss rates (transparent bars) over the last 10 to 13 years, depending on the season, are presented alongside loss rates reported in 2020-21 (opaque bars).

To calculate loss rates for individual states, we assigned beekeepers to all states where they reported managing colonies during the survey year. As a result, most backyard beekeepers were assigned to one state. Conversely, some sideliner (7.0%; n = 86) and most commercial beekeepers (74.3%; n = 35) moved their colonies across state lines, so their loss rates were included in the loss calculation for all the states in which they managed honey bee colonies. State loss rates varied considerably over the country (Fig. 3; for historic state loss rates see <https://research.beeinformed.org/loss-map/>).

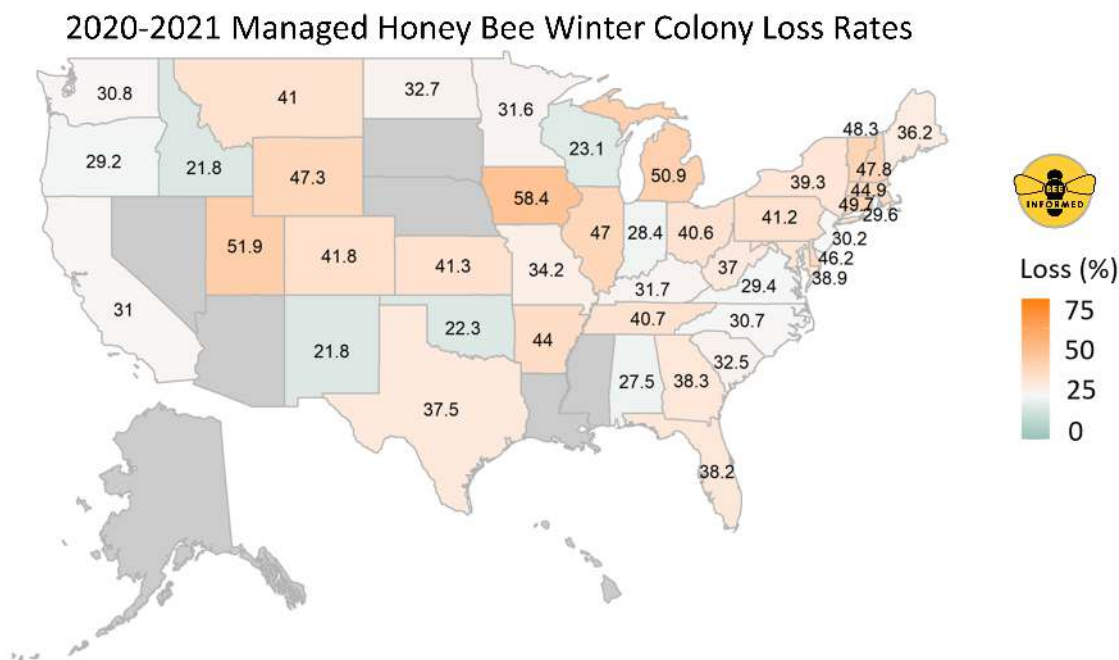


Figure 3: Managed honey bee colony loss rates in the United States for the Winter 2020-21 survey period (1 October 2020 - 1 April 2021). States with less than 10 respondents were omitted (grey fill).

Responding beekeepers were asked to identify up to the three main causes of colony loss in their operations. Beekeepers from all operation types reported that the parasitic *Varroa destructor* mite was the main cause of colony loss over the winter (Fig. 4), with commercial beekeepers citing queen issues as a close second. Reported reasons for summer losses were slightly different, with queen issues, followed by the varroa mite, listed as most and second most important by all beekeeping operation types, respectively.

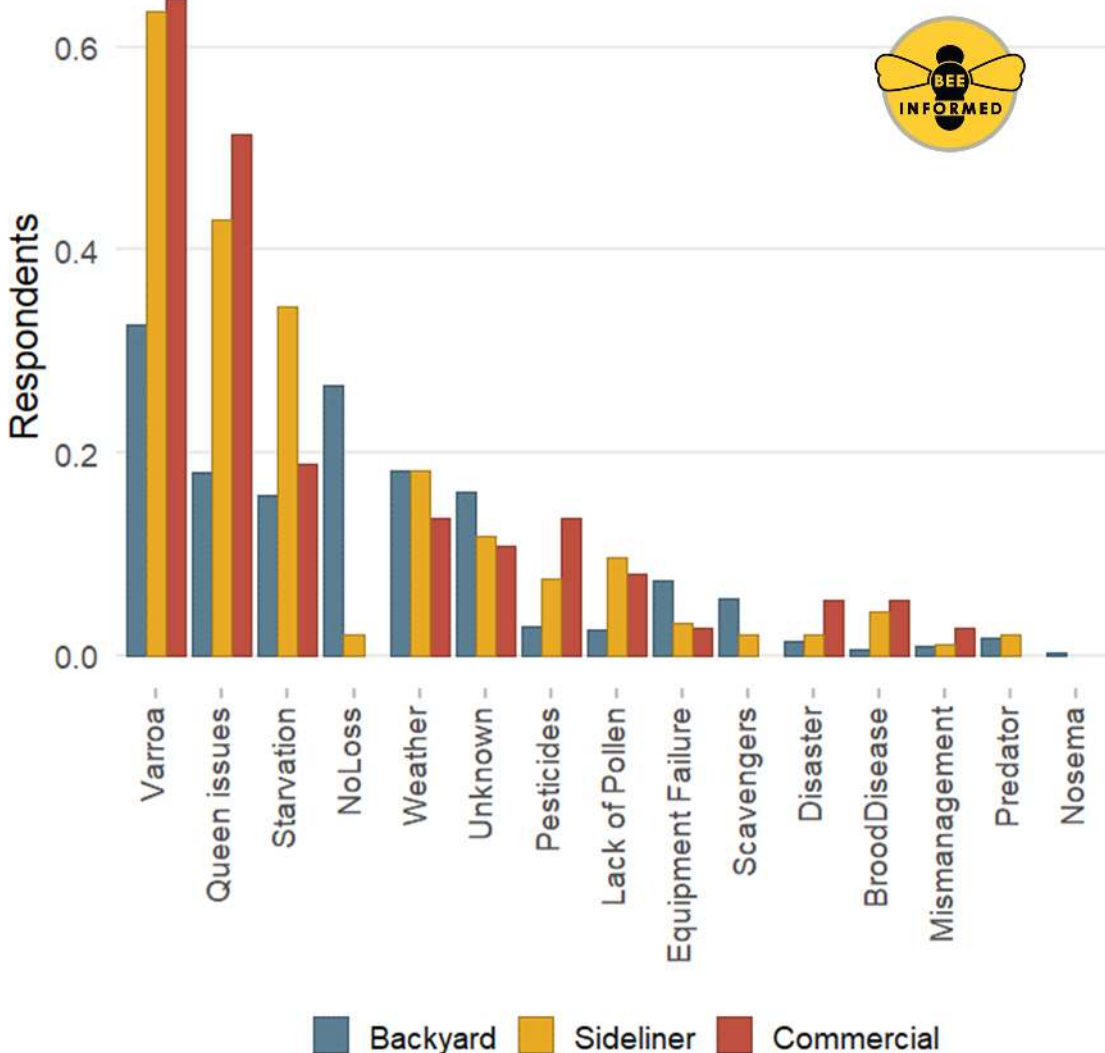


Figure 4: Self-reported cause of loss of managed honey bee colonies in the United States according to beekeeping operation type (n = 3,217 backyard, 93 sideliners, 37 commercial respondents) for the Winter 2020-21 survey period (1 October 2020 - 1 April 2021).

While a queen issue like death or poor performance can lead to the loss of a honey bee colony, there are possible interventions. For example, colony losses can sometimes be prevented by providing a queenless colony with a queen or by actively replacing a queen with a younger one. New queens are not only used to correct queen issues, but they are also essential for beekeepers to restore colony numbers through splitting strong surviving colonies into two or more units. New queens can be provided to colonies in different ways, and similarly new colonies can be established using several distinct practices; both these topics were explored in this year’s survey. For example, only half of backyard beekeeper respondents replaced queens in their colonies over

the summer of 2020 (49.9%; n = 3,019). In contrast, most sideliners (89.3%; n = 84) and virtually all commercial beekeepers (97.1%; n = 35) provided new queens (Fig. 5).

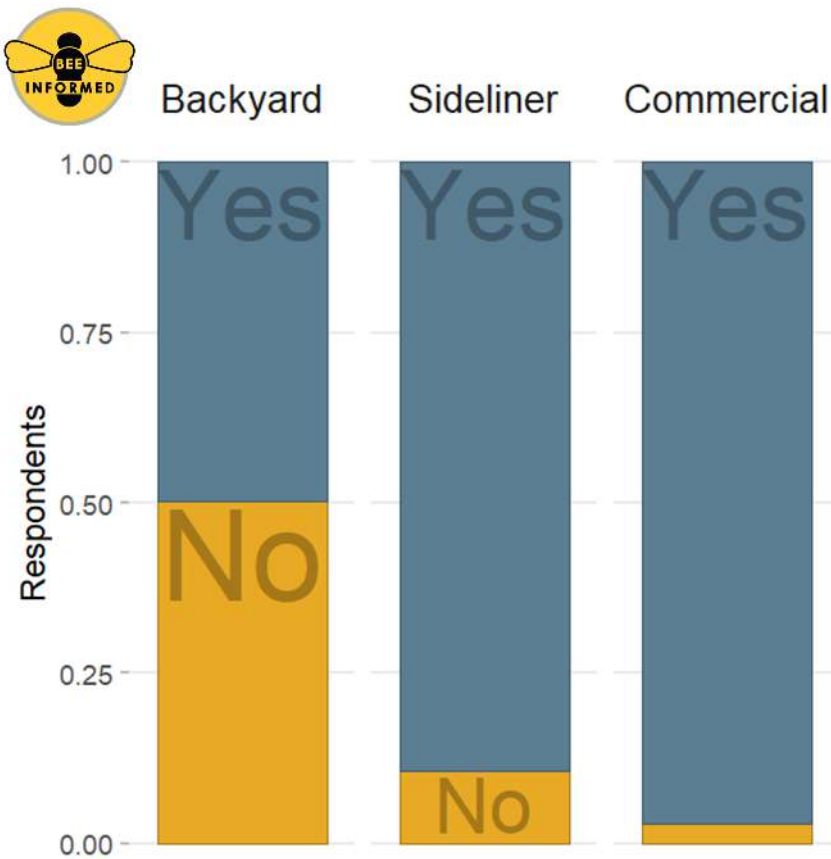


Figure 5: Proportion of beekeepers that introduced a new queen (Yes) into their colonies during Summer 2020 according to beekeeping operation type (n = 3,019 backyard, 84 sideliners, 35 commercial respondents). While only half of backyard beekeepers (managing 50 or fewer colonies) provided a new queen to their colonies in summer (1 October - 1 April), the majority of sideliners (managing 51-500 colonies) and commercial beekeepers (managing 501 or more colonies) did.

Although the total number of honey bee colonies in the country has remained relatively stable over the last 20 years (~2.6 million colonies according to the USDA NASS Honey Reports), loss rates remain high, indicating that beekeepers are under substantial pressure to offset losses by creating new colonies every year. New colonies can be obtained by splitting strong colonies into two or more smaller units, purchasing packaged bees or nucleus colonies (nucs), and/or catching swarms. Each of these practices are commonly employed to compensate for colony losses. The Bee Informed Partnership's Annual Loss and Management Survey offers an important record of such loss rates experienced by beekeepers across the United States each year. Before the start of the survey in 2007, no rigorous record was kept of the loss rates of colonies, making comparisons to historic levels difficult. In the last 15 years of the survey, our results have highlighted large variability in colony loss rates, not only among beekeeping operation types and locations, but also from year to year.

To obtain more information about the Bee Informed Partnership's annual National Colony Loss and Management Survey, visit: <https://beeinformed.org/citizen-science/loss-and-management-survey/>.

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