HiveSmart^HQ

Hive Population - Estimating Method

Overview

Users can now enter an estimated *Hive Population* value in each **Service**. When a *Hive Population* value is not provided, a value is automatically calculated instead.

The *Hive Population* feature started in **HiveSmart^HQ** v1.6.0. A *Hive Population* value is also calculated for each existing **Service** when updating to version 1.6.x(+) from an earlier version**.**

There are several methods and much research available online about estimating Hive Populations. We have chosen an easy to understand method that is uses key data captured in **HiveSmart^HQ**.

The objective is a reasonable ballpark *Hive Population* value for tracking changes over time.

A calculated *Hive Population* value consists of the number of *Active Bees* plus *Brood Cells*. It takes into account whether it's an *established* Hive or one that is *beginning*. The method uses the number of Honey & Brood frames with several *Estimating Factors*.

The calculation is:

- **Active Honey Frames (A)** = *Total Honey frames* (each size) x *Active Frames %*
- **Active Brood Frames (B)** = *Total Brood frames* (each size) x *Active Frames %*
- **Active Bees (C)** = *Total Active frames* (A+B) x *Active Bees per frame (each size)*
- **Active Brood Cells (D)** = *Active Brood Frames (B)* x *Peak Cells* x average *Frame Coverage %*
- **~Hive Population** = *Active Bees (C) + Active Brood Cells (D)*

Method Details

Frame Numbers

The frame numbers used in the Hive Population calculations depend on settings in **HiveSmart^HQ**:

- For **Boxed Hives** with *Frame tracking* not used (default setting)**:** the number of frames is calculated by using the supplied number of Honey & Brood boxes (of each size) multiplied by a default number of frames (per box size). This applies when the *Frame tracking* option in **General Hive Choices** is unchecked.

- For **Boxed Hives** with *Frame Tracking* in use**,** OR **Top Bar Hives** (TBH): the frame numbers supplied in each Service are used. (For Hives flagged as a TBH, the number of "boxes" equates to the number of frames).

Estimating Factors

The default *Estimating Factors* that are applied in the calculation are:

Factor	Explanation	Default Values
Active Bees per Frame	**An average number of Workers, Drones & Foragers per (active) frame.** A relative 33%/33%/33% split is assumed. The number of foragers is difficult to assess via Frame count samples. These vary dramatically for various reasons, including the time of day, season and weather. Observational Frame counts suggest that 70% of Foragers are away from the Hive on average.	**Full (Deep): 2,300** **¾ (Medium): 1,380** (60% of Full) **½ (Shallow): 1,104** (80% of ¾) Full frame: The 2,300 value provides a split of 767/766/767, so an average frame count, excluding 70% of Foragers, would be ~1,533 (about 5 cups).

Factor	Explanation	Default Values
Active Frames %	**The proportion of Honey frames with comb and Brood frames with capped brood and larvae cells.** The default percentage is based on observation and may vary depending on a range of factors.	65%
Brood Coverage %	**The average proportion of an *active* Brood frame that has capped cells.** The default percentages are based on observational averages and may vary depending on a range of factors.	**80%** - average for an *active* Brood Frame.
Peak Cells per frame	**The maximum number of brood cells per frame (if fully combed).** This is subject to frame width and the foundation used (or bee variety if natural comb).	Full (Deep): **4,624** ¾ (Medium): **2,720** (~60% of Full)

It is possible to change the default value for each *Estimating Factor*. Do this in **General Hive Choices** (via **App Options & Settings**).

A *Re-estimate History* option is available when any of the default values change. This option will recalculate the *Hive Population* values for all existing Services (that have automatically calculated values).

The default values for each Estimating Factor is the result of research. The details are available on the **ZBees Apiary** website.

Methodology Credit: David Zachary, ZBees Apiary for the research supporting this method. Many thanks too for his invaluable input during development of this *Hive Population* feature.

Prior Service frames vs. *Current* Service frames

The calculation of the *Population* value for a Service uses the number of frames at the prior Service for that Hive - they regulate the Population capacity that is possible at the next Service.

But, there are cases where the number of frame numbers at the current Service apply instead. These include:

- When the Hive has no prior Services,
- When the Hive was "Inactive" at the prior Service and is active in the *current* Service,
- There are fewer active brood frame numbers at the end of the *current* Service than there was for the *prior* Service (i.e. the lower frame numbers in the *current* Service will regulate the *Population* capacity),
- When details of the *current* Service indicate that the Hive is in a *beginning* state (see below)*.

Beginning and Established Hives

The calculation method differentiates between two stages of development: a Hive that is *established* versus one that is *beginning*.

The Population value of an *established* Hive consists of (capped) Brood cells plus Bees collecting Honey.

For a *beginning* Hive the focus is on Brood production (rather than Honey collection). In the early days any brood cells are uncapped. In these cases, the Population consists only of the Bees working on the active Brood frames.

The Population calculation for a Hive that is *beginning* consists only of Active Bees. It ignores Brood cells (by setting *Brood Coverage* to 0%) and excludes any Honey frames.

The criteria below determine whether the Hive is in the *beginning* stage:

- If the Hive is flagged as a Nucleus,
- If the number of *Active Brood Frames* is below a threshold (= 6),
- If the number of Active *Brood* frames are below a threshold:
  - Full-size: < 2.5
  - ¾-size < 4.2*

    (*uses the ratio between Full-size and ¾ size for the *Active Bees per frame* values. If the default values are changed, such that the ratio changes, this threshold will automatically adjust)

NOTE: If 16 days or more have passed since the Hive met these criteria, the method assumes the Hive is now *established* (unless it remains flagged as a Nucleus).

The 16 day threshold is enough time for capped brood to begin emerging. Brood cells then form part of the Population calculation - along with the Active Bees per honey frame.

Minimum Population

The raw *Population* calculated may not match real-world situations when there is a small number of *Active Brood frames*. This can occur with a typical bee package Hive installation which is often into a small number of frames.

To get a more realistic result in these cases, the calculation method sets the *Active Brood frames* number to a minimum of 2.5. It also applies the default *Active Bees* (full-size) value to produce a Population of 5.8k (5,800).

Hive Population *Estimator Tool*

A Hive Population *Estimator* tool is available in **HiveSmart^{HQ}**. This helps with specifying a *Population* value when adding or editing a Service. It can also be used to perform a "what-if" analysis for the Hive *Population*. The tool is in the *Key Hive Features* section of the Service form. It is also available when adding a time-based Varroa test result (in the *Hive Health Care* section). The *Estimator* tool uses the same calculation method explained above.

The display of the *Estimator* varies. It depends on whether the *Frame tracking* option OR a *Top Bar Hive* (TBH) option are selected in **General Hive Choices** (via **App Options & Settings**):

Frame tracking option not used (default) and TBH = none (default)
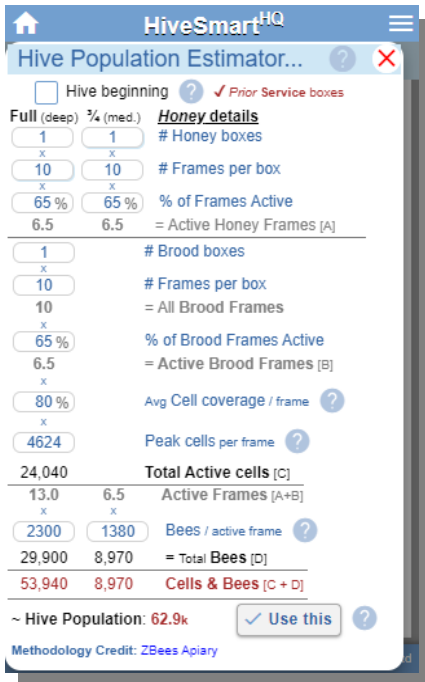
Frame tracking selected OR a *TBH* option is used. (TBH = "All" OR when TBH ="some" & Hive is *flagged* as a TBH)
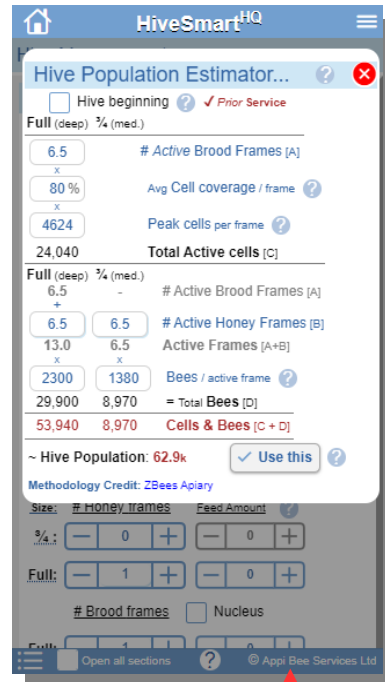
The sizes displayed in the *Estimator* reflect the size options chosen for display in **General Hive Choices**