John Harbo September 2025

A Path to Nationwide Resistance to Varroa

Probably the best thing we can do to establish nationwide varroa resistance is to stop basing our breeding decisions on the number of mites on adult bees. Counting mites on adults selects against varroa sensitive hygiene (VSH).

In his book *Parasite Rex*, Carl Zimmer describes the progression of many parasite-host relationships. The common theme is that new parasite invasions (as when varroa first entered the USA) are typically very damaging to the host in their earliest encounters. The host responds with high mortality rates. After that rough start, host and parasite gradually develop a mutually acceptable relationship.

Does this sound familiar? Our feral bees were almost non-existent for many years after the introduction of varroa. Feral colonies are back, and from my recent experience, many express VSH.

Bees with the VSH trait disrupt mite reproduction in worker brood, while continuing to allow varroa to reproduce in drone brood. That may be a good strategy, because if the VSH trait destroyed all the mites, varroa would be challenged to develop resistance to VSH. Varroa's history of developing resistance to miticides has shown that they are very capable of genetic adaptation.

VSH creates a situation where bees destroy varroa infested cells, thereby destroying the progeny. The mother mite survives, resulting in an increase in the number of mites residing on adult bees. In 1999, we called this proportion of mites in brood (PMIB), and proved that it was a highly heritable trait. That was before we understood varroa sensitive hygiene in 2005. We now realize that having a high proportion of the mite population on adult bees is caused by varroa sensitive hygiene. PMIB is a piece of the VSH puzzle. Therefore, **breeding decisions based on having fewer mites on adult bees will often be selecting against VSH.**

I used to think that there may be many mechanisms of varroa resistance. Now I'm not so sure. For example, we don't know the fate of the mites that are forced out of the brood cells. Maybe the mites are weakened by their experience and become more vulnerable to removal by worker bees. Perhaps VSH, PMIB, and ankle biters are 3 components of a single mechanism of resistance to varroa. For those who like acronyms, we could call it DMR: destruction-migration-removal. That's only an hypothesis. Prove it wrong.