Winter Bees and Clustering Behavior – Part 1

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When beekeeping, we often notice that point in the spring when the population starts growing rapidly and when the population starts to decline in the fall. But have you ever asked yourself how a honey bee colony's population fluctuates throughout the year, and when winter bees are produced? Let's take a deeper look at the different age of bees that compose the adult bee population from spring to winter, and what differentiates them from each other.

Population cycle of honey bees

The population of a honey bee colony fluctuates from 60000 bees in the summer to about 10000-15000 bees in the middle of winter. The colony will steadily grow until a few weeks after the peak honey flow, when the colony's population reaches its highest. Once the summer honey flow is over, it is normal to see a population decline. This is a natural population reduction as summer forager bees are short-lived and many die off after the honey flow. At this point, colonies will begin producing winter bees (early-mid August). These bees will have physiological and behavioral differences from summer bees. In the fall, as daily temperatures drop, queens will slow down or completely stop laying eggs and will not begin again until mid-winter or when temperatures start rising again.

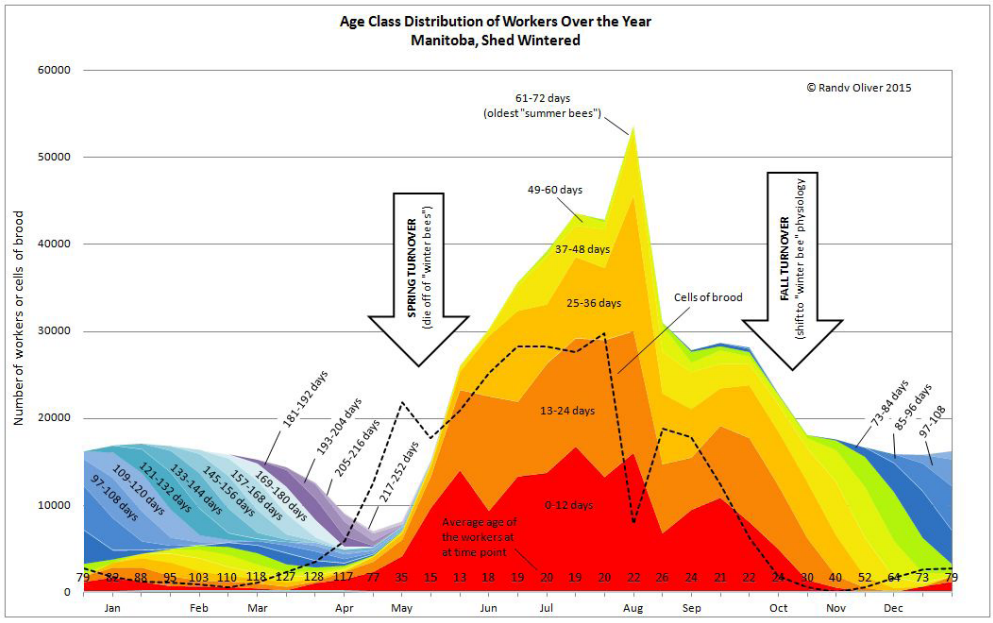

Fig 01. Seasonal demographics of a colony headed by a vigorous young queen, shed wintered in Manitoba. Each band of colour represents the proportion of bees in each 12-day age class at any time point. Red (0-12 days of age) through green (61-72 days) age cohorts represent short-lived "summer bees," which rarely live longer than two months. The blue and violet age classes are the long-lived "winter" (diutinus) bees that hold down the fort when there is no incoming pollen (and thus little recruitment). The dotted line represents the number of cells of brood. The numbers along the x axis represents the average age of all bees in the hive at any time point. * Image created by Randy Oliver (2015; *https://scientificbeekeeping.com/colony-demography/*) with data collected by Lloyd Harris.

Signaling change

Several factors initiate a colony to slow brood production. The interaction between the changing availability of food resources, conditions within the colony, temperature, and daylight are thought to signal this change.

As fall approaches there are fewer sources of pollen available, a critical protein source for brood production. Nurse bees need this protein to support the production of major gland secretions that make up what we know as 'brood food'. If there is less pollen coming in, then the nurse bees' ability to secrete brood food and support developing bees is impeded. Remarkably, honey bees are able to adjust the amount of brood being produced based on the amount of pollen available. Therefore, if there is no pollen available then brood rearing will come to a halt.

With fewer food resources available, foraging also decreases resulting in more forager bees remaining in the colony. Forager bees release a pheromone that slows down the maturation of nurse bees into foragers, further limiting the resources coming into the colony. As fall approaches, temperatures drop, and days become shorter. As a result, bees have less time for foraging activities.

Seasonal changes (e.g., temperature, daylight, nutritional resources availability) not only trigger a decrease in brood production, but also seem to induce the appearance of winter bees in the colony.

What makes a winter bee a winter bee?

Winter bees are physiologically different than summer bees. They weigh more, have wider abdomens, enlarged fat bodies (increased lipid and protein content), and more developed hypopharyngeal glands. Winter bees' protein, triglycerides, glycogen, and glucose levels are higher than those of summer bees, which allows them to live 4-5 times longer than their

summer counterparts. Another characteristic that sets these two bee 'profiles' apart is their Juvenile Hormone (JH) and Vitellogenin (Vg) levels. Studies have shown that winter bees maintain a fairly constant JH/Vg levels (low JH and high Vg) throughout the winter, a JH/Vg profile that is similar to those of nurse bees. As spring approaches, winter bees initiate a physiological transition to becoming forager bees as their JH decreases and Vg increases, a JH/Vg state that is characteristic to foragers.

So there you have it! This is why and how winter bees are able to survive the entire winter, perform colony thermoregulation, and support early spring colony growth. Coming up next month will be: Winter Bees and Clustering Behavior – Part 2: Winter Cluster Dynamics".

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